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MASTER THESIS

A MODEL TO DETERMINE CREDIT RATING

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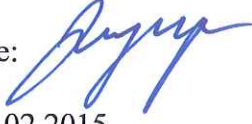|		
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ABSTRACT

A MODEL TO DETERMINE CREDIT RATING

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Turkey has an institution-based finance system. In this system all types of businesses acquire the necessary funds mostly from the banks. That is why banks are the most important financial institutions in Turkey. In this regard the most important risk that the banks face is credit risk, which can be defined as the probability of default by the customer and subsequent loss incurred by the bank as a result of the default. For this reason it is of utmost importance by the banks to manage their credit risks efficiently. One of the ways to accomplish this objective is to evaluate the credibility of the businesses that apply for a loan or a line of credit. This evaluation process is called credit rating. In this thesis a multivariate statistical model is developed to accomplish the credit ratings of the businesses that are the potential loan customers of a bank. A unique data set is formed from the loan applications of a bank. Businesses whose loan applications are accepted and businesses whose loan applications are rejected are included in this data set. These businesses form the cases of the model. Independent variables are financial data (financial ratios and percentage changes). The best model for credit rating is found to be the logistics regression model (logit model). The most important variables that distinguish accepted and rejected businesses are found to be the net profit margin and debt ratio.

As net profit margin increases, probability of acceptance increases. As the debt ratio increases probability of rejection increases.

ÖZET

KREDİ DERECELENDİRME ÜZERİNE BİR MODEL BELİRLEME

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Türkiye'de kurum tabanlı bir finansal sistem bulunmaktadır. Bu sistemde her çeşit işletmeler ihtiyaç duydukları fonları çoğunlukla bankalardan temin etmektedirler. Bundan dolayı, bankalar Türkiye'deki en önemli finansal kurumlardır. Bu bakımdan bankaların yüz yüze oldukları en önemli risk de, alınan kredinin geri ödenmemesi olasılığı ve bunun sonucunda bankanın uğrayacağı zarar olarak tanımlanabilecek, kredi riskidir. Bu nedenle bankaların kredi riskleri etkili bir şekilde yönetmeleri çok önemlidir. Bunu başarmanın yollarından birisi, kredi ve kredi limiti için başvuran işletmelerin kredibilitelerinin değerlendirilmesidir. Bu değerlendirme süreci kredi derecelendirimesi olarak isimlendirilir. Bu tezde, bir bankanın kredi müşterisi olabilecek işletmelerin kredi derecelendirmelerinin yapılmasını sağlayacak çok değişkenli istatistiksel bir model geliştirilmiştir. Bir bankaya yapılan kredi başvuralarından özgün bir veri seti oluşturulmuştur. Kredi başvurusu kabul edilen ve kredi başvurusu reddedilen işletmeler veri setine dahil edilmiştir. Bu işletmeler modelin vakalarını oluşturmuştur. Bağımsız değişken olarak finansal veriler (finansal oranlar ve yüzde değişimler) kullanılmıştır. Kredi derecelendirme için en iyi model lojistik regresyon modeli (logit modeli) olduğu tespit edilmiştir. Kredi başvrusu kabul edilen reddedilen işletmeleri ayıran en önemli değişkenlerin net kâr marjı ve borçluluk oranı olduğu belirlenmiştir. Net kâr marjının artışı kredi başvurusunun

kabul edilmesi olasılığını artırmaktadır. Borçluluk oranının artışı kredi başvurusunun reddedilmesi olasılığını artırmaktadır.

Anahtar Kelimeler: Kredi derecelendirmesi, bankacılık, krediler, çok değişkenli istatiksel yöntemler

ACKNOWLEDGEMENTS

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INTRODUCTION

Turkey has an institution-based finance system. In this system all types of businesses including corporations acquire the necessary funds from financial institutions as opposed to acquiring the funds from the capital markets by issuing securities. Dominant financial institutions in Turkey are the banks. Banks in Turkey provide loans to both individuals and businesses. So, all types of businesses (sole proprietorships or corporations, small, medium or large sized businesses) are among the loan customers of the banks.

Asset quality is an important concept for the banks and the most important element in this concept is the quality of the loans. Businesses or individuals that do not pay off a loan constitute the most significant risk for the banks. The resulting delay in loan repayments represents a potential risk. For this reason, banks should manage their credit and loan originating operations efficiently. One of the most important elements in loan originating process is to evaluate the credibility of the loan applicant. If a bank does not pay enough attention to this element, then it may face non-performing loans that create losses for the bank. It is one of the most important goals of the banks to reduce the amount of non-performing loans. Evaluation of credibility (in other words credit rating) is of utmost importance to achieve this goal for the banks. Amount of non-performing loans directly affects the asset quality of a bank.

Credit risk is one of the major risks that the banks and the financial institutions face. Credit risk can be defined as the probability of default by the loan customer. High credit risk also affects the capital requirement of a bank. Financial institutions and banks try to minimize the credit risk (in other words default risk) by using statistical techniques to classify the loan applicants into risk classes such as high risk applicant or low risk applicant. A good credit evaluation (credit rating) is a very important process for a bank that originates business loans. Banks try to measure the credibility of the companies to reduce the credit risk.

Bank's main purpose is to keep the firms which are in the current loan portfolio. On the other hand banks try to find new and "low risk" companies to extend their loan portfolios. Because of fierce competition among banks, banks are trying to originate as many loans as possible. At this point, it is important to attract low risk companies and include them in the loan portfolio. Otherwise, the amount of the non-performing loans increases. For this reason banks should pay attention to analyze the firms that apply for a loan correctly and make the decisions according to the regulations.

Positive answers to the loan applications should be given to the firms that have cash generating capacity that has the ability of making loan repayments from their commercial activities, that have satisfactory good financial data, and that have managers with high morality. The most important point is the evaluation of the business.

The main purpose of this study is to explain loan origination process and determine the important financial variables that distinguish acceptable loan applications from the unacceptable ones.

The first chapter of the study provides general information about loan and the importance of loan applicant's evaluation. The second chapter of the study consists of the literature review. In the third chapter financial variables used in the study and their importance is explained. In the third chapter multivariate statistical methods used in the study are also explained. In the fourth chapter analyses are presented. Last chapter presents the conclusions.

As a result we can say that the main purpose of this study is to determine the important financial variables that have an impact on the credibility of loan applicants and estimate a model through multivariate statistical methods to be used in credit rating. The benefits of the study are twofold. First benefit is for the businesses that desire to take out a loan from the banks. Businesses can understand what are the important factors that cause a loan application to be accepted or rejected and as a result they can improve their positions in those factors to facilitate access to bank

financing. Second, banks can use the model to evaluate the credibility of the loan applicants.

CHAPTER 1

1. LOAN FACILITY

1.1. GENERAL INFORMATION ABOUT LOAN

1.1.1. A General Outlook On Loan:

One of the most important functions of a financial system is to make resource allocation decisions. These decisions help determine "what is to be produced" and "how much it is to be produced". Financial systems fall into two groups: bank-based and market-based. Acquiring of funds (financial resources) is mostly based on the issuance of securities (stock or debt securities) in the market-based system. In the bank-based system, on the other hand, it is mostly based on the loans supplied to companies by the banks.

Another issue about loan, which is regarded as the foundation of banking, is credit risk. There is a direct relation between the credit risk level and the quality of the company to which the loan is supplied. Therefore, company selection is one of the most important stages in originating a loan. Company selection is followed by marketing, allocation, supplying the loan, and follow-up of the company's performance. These stages will be explained in detail later in this section.

1.1.2. The Definition of Loan:

The Turkish Language Association defines loan as "lending money, property, or any asset that can be measured in monetary units to be taken back in a particular time and in particular conditions". Thus, loan can be defined as banks' lending of the deposits collected from depositors to customers who need them with a specific price (interest or commission fee) and repayment condition (term). It should

be kept in mind that the main area of activity of the banks is the collection of deposits and loaning them.

Article 48 of the Banking Law No. 5411 specifies what operations may be deemed as loan though it does not explicitly a define loan. This article of the Banking Law is as follows:

The cash loans and non-cash loans such as letters of guarantees, counter-guarantees, suretyships, avals, endorsements, banker acceptances and commitments bearing such characteristics, bonds and similar capital market instruments that have been purchased, funds lent through making a deposit or other ways, receivables arising from the installment sales of assets, overdue cash loans, accrued but non-collected interests, values of non-cash loans that have been converted to cash, receivables incurred from reverse repurchasing transactions, risks undertaken within the scope of futures and option contracts and other similar contracts, partnership shares and transactions recognized as loan by the Agency shall be considered as loans in the implementation of this Law, irrespective of the accounts they are recorded.[1]

For the implementation of this Law, in addition to those mentioned in the first paragraph, loans shall also include the financing provided through the financial leasing method by development and investment banks, the payment of all movable and immovable property and service fees of participation banks or the profit and loss sharing investments, immovable, equipment or property procurement or financial leasing or joint investments by financing documents in return for property, and similar methods.

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[1] The Banking Law no. 5411, Article: 48 -- https://www.bddk.org.tr/websitesi/turkce/Mevzuat/Bankacilik_Kanunu/1540bankacilik_kanunu_13.9.2013.pdf

Loan has no definite definition from legal perspective. "The freedom of contract" included in the Code of Obligations allows parties to determine the conditions of loan.

1.1.3. The Elements of a Loan

A loan has four main elements: time, trust, risk, and income.

1.1.3.1. **Time**: Money lent or loans supplied by the banks have to be repaid after a specific time. Therefore, compliance between loan type and credit period is very important. Risk varies by the length of the credit period. As this period gets longer, risk increases because of the uncertainty of future.

1.1.3.2. **Trust**: Trust is needed because loan originated as cash, property, guarantee, suretyship, or in any other way has to be taken back after a particular time. The person or the institution taking out a loan has to have some reputation and credibility in the eye of the bank. This is because; trust is the most basic element of loan.

1.1.3.3. **Risk**: In banking, risk refers to sum of hazards that may occur until the lent money is collected or the commitment subject to the guarantee given is fulfilled. It generally includes failure in repaying the loan timely and completely and complying with the conditions set forth in the loan agreement. Since banking includes risky operations, special importance should be attached to risk management. Loans are the most important item posing a risk.

1.1.3.4. **Income**: Banks need to generate an income (e.g. interest and commission fee) by using their current funds and the resources they have acquired in different ways. The income generated by originating a loan includes interest and/or commission fee. Interest is the time value of money that is expressed as a percentage of the principal amount borrowed based on a predetermined rate and period that is demanded by the bank to compensate for the transfer of benefiting from the money to the borrower. Commission fee, on the other hand, refers to the costs caused by some operations carried out by the creditor to originate a loan.

Main reasons for banks to earn the above-mentioned incomes are as follows;

-They need to continue their operations and improve themselves,

-They need to fulfill their responsibilities towards depositors,

-They need to generate profit for their shareholders.[2]

1.1.4. The Functions of Loan:

The most important function of commercial loans is to allocate resources for those businesses, which are in need of funds, thereby contributing to the development of businesses and helping economic growth. Thus, loans are very important for the maintenance of economic activities. In addition, they accelerate commercial activities by removing the need to keep cash, help decrease unemployment by contributing to national income, and facilitate providing supply and demand equilibrium by bringing in fund surpluses to the market.

1.1.5. The Types of Loan:

Classification of loans by their characteristics is important for loan management. Criteria such as period, intended use, sector, area of use, and collateral are taken into consideration in the classification of loans.

1.1.5.1. Loans by characteristics: Loans fall into two groups by characteristics: cash loans and non-cash loans.

Cash loans are the loans, which are originated by lending money to be repaid in a particular period (e.g. revolving loan, spot loan, commercial loan, personal loan,

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[2] http://izmir.tarimkredi.org.tr/koopdokuman/kredilerdersnot.htm

vehicle loan, real estate loan, consumer loan, etc.). Banks originate these loans in return for a specific interest and commission fee.

Non-cash loans are the loans that are originated for performing a particular work, undertaking a commitment, and providing a guarantee for it. The credit period is limited with the end time of work (e.g. letters of guarantee, letters of credits, acceptance credits, endorsement loans). There is no cash outflow in these kinds of loans. Thus, banks do not demand any interest. However, they may get a commission fee for the loans originated.

1.1.5.2. Loans by maturity: Loans fall into three groups by maturity: short-term, medium-term, and long-term:

Short-term loans are the loans to be repaid in at most 1 year (e.g. cash management loan which is supplied for urgent intraday needs and repaid on the same day).

Medium-term loans are the loans to be repaid in 1 to 5 years (e.g. business loans, loans used for purchasing tangible assets such as machinery and equipment that are needed for increasing the capacity, loans originated for investments that are to be completed and create cash flow by commencing production in five years).

Long-term loans are the loans supplied for 5 or more years. They are used for financing fixed assets such as factories, roads, and dams, which start to create cash flow after a long time.

1.1.5.3. Loans by collateral: Loans fall into two groups by collateral: secured loans and unsecured loans:

Unsecured loans are the loans supplied to a customer depending on her/his/its reputation or relations with the bank without demanding any security. Secured loans fall into two groups: personal security loans and loans on collaterals. In personal security loans, natural persons or legal persons who are found, through intelligence

and analyses, to have high credibility stand surety for the company that gets a loan provided that such company remains the principal debtor. Loans on collaterals, on the other hand, are the loans supplied by a bank on condition that a property, which can be regarded by the bank as a security, is put in pledge by it. Property subject to pledge can be tangible property such as vehicles, real estate (e.g. lands, fields, buildings, vehicles, etc.), goods, and precious metals. Assets such as checks, bonds, treasury bills, government bonds, investment funds, and stocks that can be accepted by the bank are also collaterals.

1.1.5.4. Loans by permit: Loans by permit fall into two groups: loans under the authority of branch and authorized loans.

As explicitly stated in the article 51 of the Banking Law, loan allocation is under the authority of the board of directors of the bank. However, the board of directors may delegate this authority to the general directorate of the bank, and the general directorate may transfer such authority to relevant regions and branches. The loans that exceed the limits under the authority of the branch are called authorized loans. All the companies included in the present study are authorized.

1.1.5.5. Loans by currency: Loans by currency fall into two groups: loans in Turkish Lira and foreign-currency loans. There are also loans that are indexed to a foreign currency.

1.1.5.6. Loans by resource: Loans by resource fall into two groups: loans originated by credit institutions (banks) from their own resources and loans originated by credit institutions (banks) from other resources that do not belong to the bank.

The first group mentioned above includes the loans originated from the bank's own funds. The components of a bank's own funds include paid-in capital and retained earnings. The article 54 of the Banking Law explanatorily indicates loan limits and states that the total amount of loans to be extended by a bank to a real or a legal person or a risk group **shall not be more than twenty-five percent of its own funds.**

The second group given above includes the loans originated from non-bank resources (e.g. bond and bill issue, loans acquired domestically, and loans acquired from abroad).

1.1.5.7. Loans by intended use: Loans by intended use fall into two groups: consumption loans and production loans:

Consumption loans (or consumer loans) are the loans taken out by individuals who are not engaged in commercial activities. The main purpose of these loans is to make investments (e.g. purchase a house, purchase a car) or to meet their consumption needs (e.g. goods, education, vacation, etc.). Payment conditions, terms, and interest rates are determined before these loans are originated, and the loans are repaid based on a particular payment schedule. Usually, a fixed-rate repayment schedule is created based on the monthly income of the person. Variable rate real estate loans are also available.

Production loans (or business loans) are used to provide the funds that are needed by businesses for purchasing materials, paying freight charges, paying relevant fees, marketing and R&D activities, purchasing machinery and equipment, building a plant, etc.

1.2. LOAN NEEDS OF BUSINESSES

1.2.1. Lack of Savings and Capital Accumulation

A business that cannot find adequate funds to finance its investments due to lack of capital accumulation, low propensity to save, and unbalanced income distribution turn to debt capital. When a company fails to do with its own funds and such funds turn out to be negative, it is deemed risky for loaning. However, evaluating a company's equities based on profitability helps obtain more accurate results in credit analysis. [3]

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[3]   http://www.dunya.com/kobilerin-sermaye-benzeri-kredi-ihtiyaci-girisim-sermayesi-risk-sermayesi-131204h.htm

1.2.2. The Need for Financing

The need for financing emerges automatically because of businesses' increased receivables, inventories, debts, and tangible assets. The financing for a company must be accessible, adequate, permanent, regular, and at a low cost. The banks, which intend to originate a loan to a growing company, must accept these conditions. In this way, they acquire a low-risk and profitable company as a customer.

1.2.3. The Need for Financing Due to Problems Encountered in the Cash Conversion Cycle

The cash conversion cycle (CCC) is calculated by using the following formula:

$$CCC = DIO + DSO - DPO$$

DIO: Days Inventory Outstanding + Days Sales Outstanding - Days Payable Outstanding.

Increase in days sales outstanding and days inventory outstanding and decrease in days payable outstanding cause meeting the cash need through a loan if it cannot be met via equity.

1.2.4. Fixed-Asset Investment by Businesses:

If a business demands a loan for a fixed-asset investment, the bank needs to do the necessary feasibility study concerning the related investment and to make necessary analyses on the efficiency of investment and payment performance.

1.2.5. Loan Need to Exploit Opportunities:

The businesses whose main objective is to achieve a sustainable growth by making profit in the long term need financing to exploit some opportunities in their sector. In this context, there may be loan need for many reasons including but not limited to the expected rise in the price of a product sold due to inflationist pressure or any other reason, intention to purchase a tangible asset that is put up for sale for a price below its real value, and wish to acquire a rival company.

1.2.6. Speculative Loan Need:

Companies may demand a loan for speculative purposes. At the present time, speculations on property, securities, and foreign exchange are common. In loans on commodity and securities (especially shares), banks must investigate whether or not the loan demands are for speculative purposes (Akgüç, 2006:4).

1.3. LOANING PROCESS

Loaning process starts with marketing. Finding a customer and selling him/her/it the bank's products are the first stage. Even if a customer applies himself/herself/itself, other processes may come into play if the bank's products are introduced and a healthy communication is initiated.

The second stage is allocation. The conditions of the loan to be allocated are determined based on the credibility and needs of the customer. The magnitude of a risk undertaken by a bank is in direct proportion to the accuracy and transparency of analyses. Loaning process refers to the entire process in which the amount of the loan to be allocated for a company, collaterals, interest/commission rates to be applied, term/mode of payment, etc. are determined; the loan is originated; and then it is collected and discharged.

1.3.1. 5 C's in Loaning

Commercial banks and investment banks allocate loans to companies by carrying out some observations and measurements based on the term 5 C's. The main purpose of the banks in taking these principles as a basis in the loaning process is to create an efficient and sound loan portfolio by making the most appropriate decisions through an effective credit rating. Acting based on just one of these concepts or ignoring one or some of them may cause a bank to face certain adversities (Öker, 2007:104).

What should a bank expect from a company and what should it pay attention to when it is originating a loan? Though every credit situation is unique, many banks utilize 5 C's in evaluating the loan demands. This study discusses these concepts one by one in an attempt to determine "how they affect loaning".

1.3.1.1. Character: Banks wish to make sure based on the payment performance and behavior module of the company that demands loan that the loan to be originated is going to be used efficiently and repaid. Any suspicion about the repayment of the loan by the company is taken into consideration in evaluating the loan demand.

1.3.1.2. Capacity: A company's capacity refers to its ability to repay the loan. Analyses focus on whether or not the company has enough liquid assets to meet its short-term liabilities and whether or not it has enough investment efficiency to manage its medium-term and long-term liabilities. The company's capacity must be evaluated soundly so that there is no problem in the repayment of the loan. The liabilities of a company can be followed up through its consolidated records. If there is an inconsistency between the financial liabilities of a company and the risks indicated in the consolidated records, the bank may focus on the probability of informality in financial data.

1.3.1.3. Capital: The amount obtained by deducting the total liabilities of a company from the total assets in its balance sheet indicates its equity. It is used as an informative element in credit evaluation. The company's equity also provides

assurance for the repayment of the loan. If it is assumed that the company will make a loss in the forthcoming period, the strength of equity may be considered a positive aspect implying that the company's loss for the period may be endured.

1.3.1.4. Conditions: Being institutions that meet loan needs, banks must make sector analyses regularly, inform their staff of the direction of the economy continuously, and have alternative plans to manage loans in the face of any possible adversity. In this way, they can see the situation of a company in the related sector, its market share, and its state relative to its competitors. That is the only way of overcoming non-repayment risk of the loan.

1.3.1.5. Collaterals: Banks wish to guarantee their receivables against any non-repayment risk of the loan through collaterals or personal guarantees depending on the risk level of the company. Since not enough information is held in regard to the payment patterns and performance of those customers that are to get a loan for the first time, loan is allocated to such customers in return for collaterals in the first place. Loan is allocated to these customers in return for other guarantees if necessary after enough positive judgment is rendered about the payment patterns and performance of them.

Loan on guarantee of shareholders and/or third parties is approved for companies with high credibility. High-margin collaterals may be demanded besides personal guarantees for other companies. Banks always prefer to extend loan by taking securities such as assets with high liquidity, real-estate mortgage, and pledge of commercial enterprise.

1.3.2. Functioning of the Loaning Process and the Allocation Principles of Banks:

1.3.2.1. Functioning of the loaning process:

The loaning process consists of four main stages (Altman, 1985:475-476). These stages are as follows:

- Marketing of loan / loan application,
- Loan evaluation (analysis),
- Restructuring the loan,
- Following up and checking the loan.

The functioning of the loaning process starts with marketing/application. An attempt must be made to see the activities of the company on site and to know the company better during visits to the company, which has already been a loan customer or which is a new loan customer candidate, that are paid prior to loan offer. All the companies included in the current loan portfolio must be visited on site at reasonable times. Loan must be allocated by determining the loan need of a company exactly through analyzing the activities of the company and its business plans for the forthcoming period well.

Loan demands must be evaluated and concluded based on objective criteria. The goals of a bank in loan allocation are to provide high quality service, to measure the possible risks to be taken by the bank in a sound manner, to analyze risks, and to try to minimize these risks.

Loan allocations must include a term and a repayment schedule appropriate to the customer's intended loan use, expected cash flows, nature of the work financed, and the features of the product so that the bank's resources are used efficiently. The repayment schedule and conditions of a loan must be determined by considering the financial capacity of the customer in such a way that the customer's needs are met, and they must be compatible, as much as possible, with the timing of the cash flows

that is to be used for repaying the loan. In the contracting sector, loan evaluation is made exceptionally. The companies engaged in the contracting sector may perform contracting works such as electrical works, heating works, ventilation works, and sanitary system works besides the construction of buildings, roads, bridges, dams, ports, and public facilities. Most of the operations in this sector are contractual. Works are undertaken through by tender or negotiation. Works undertaken by a contracting company may not be completed in the calendar year in which the contract has been signed. Projects, which are not finished in the same calendar year as they have been started, are called projects spread over years (long-term projects). According to the Turkish Tax Laws, the expenses and revenues related to the long-term projects of the contracting company are accumulated in the balance sheet until the project is finalized. When the work is completed, they are transferred to the income statement from the balance sheet. In a contractual work, the feasibility and duration of the work and the debtor's capacity to manage it must be measured well.

Enough information must be collected about the repayment sources of the debtor. The company's current situation, its payment performance in the past, and its cash flow projections must collectively be taken into consideration in order to determine its repayment capacity. In determining loan limits, the company's size of assets, margin equity, turnover, indebtedness, and the collateral proposed must be taken into account. The loan burden that can be handled by a customer must be evaluated based on not only the loan extended by a single bank, but the sum of all loans extended by other banks/other financial institutions.

The stages following the loan extension must be managed in a disciplined way in order to have a sound loan portfolio and collect receivables timely and completely. The financial structures and businesses of the company using a loan must be followed up closely even after the loan is originated. The company's activities must be monitored closely by getting its financial data once every three-month and paying visit to it on a regular basis.

1.3.2.2. The allocation principles of the banks:

Information about loaning stages is given above based on the principles set forth in the Banking Regulation and Supervision Agency (BRSA) "Draft Guide on Credit Management of Banks":

Principle 1- *Banks determine strategies regarding their credit operations and develop policies and implementation procedures appropriate to these strategies:*

Market conditions, the bank's risk appetite, expected profitability level, and equity levels are taken into consideration in determining credit strategies. The financial and the economic indicators used for determining the strategies are examined regularly. In addition, the balance between the risk cost and the risk return is taken into account. Credit strategy includes short-term, medium-term, and long-term plans.

Principle 2- *Banks create marketing, collection, monitoring, and follow-up policies depending on the complexity of operations and loan volume.*

Credit policies are established in accordance with credit strategies on the basis of prudence, continuous viability, and customer's credibility. Economic outlook, the pattern of capital adequacy ratio of the bank, and amendments in the related regulations are taken into consideration in reviewing the credit policies. Policies concerning corporate and commercial loans are prepared based on loan types, the qualifications of customers, sector, country, region, etc. Policies concerning personal loans are prepared based on loan types, customers' income, wealth, occupation of the customer, age, etc. Collateral policies are established based on customers' qualifications, sector, country, region, loan types, etc. The capital adequacy ratio of the bank is taken into consideration in forming collateral policies.

Principle 3- *Detailed credit procedures are formed in line with bank strategies and policies.*

The loaning process consists of stages such as marketing the loan, allocating the loan, transferring the loan amount, following up the loan, and discharging the loan. Credit procedures regulate the loaning process in an explicit and detailed way and clearly indicate the authorities and responsibilities of the staff taking part in the loaning process.

Principle 4- *Organizational structure related to credit operations is formed by making sure that it ensures functional separation of tasks and does not cause conflict of authority.*

Authorizing a loan is transferred based on the loan type, the loan size, and the nature of the collateral. The board of directors and the general directorate monitor whether or not the a loan is authorized within the delegated limits, develop checking procedures needed to detect authority exceeding, evaluates the risks resulting from loan extensions involving authority exceeding, and makes sure that appropriate measures are taken.

Principle 5- *Banks measure the performance of units and staff included in the loaning process based on explicit and predetermined criteria.*

Principle 6- *Information and documentation concerning loans are stored in such a way that they can be accessed on customer basis easily.*

Information and documentation related to loans are updated in such a way that allows reaching a judgment about customers in order to ensure efficient use of credit files. These files are kept in a way allowing accessing customer details easily if any information is needed.

Principle 7- *Sound credit management is directly associated with the effectiveness of information systems. The data obtained from information systems help units conducting credit operations and top management fulfills their responsibilities in a sound manner.*

Banks must have information systems and analytical techniques allowing efficient credit management. They employ measurement techniques that are appropriate to the nature and the amount of risks they carry because of their operations and depend on reliable data and check the validity of such techniques regularly. The information systems used by banks must be capable of analyzing credit risks at product or portfolio level.

Principal 8- *Within the framework of credit follow-up operations, information systems appropriate to the size and the complexity of operations are established.*

Principle 9- *Credit management operations are subject to inspection by units that are within the scope of internal systems on a regular basis.*

Regular inspections and controls are carried out to determine whether or not loaning processes are conducted in accordance with the bank's credit policies and procedures; whether or not loans are originated based on the procedures and principles established by the board of directors; and whether or not the terms, amounts, and qualifications of loans are reported to top management accurately.

Principle 10- *In the stage of marketing the loan, customers must be informed all aspects of the products accurately.*

Bank's employees must have adequate knowledge about the credit products to be marketed. Customers are adequately informed about the loans including risks and costs.

Principle 11- *Loan customers are selected in accordance with the bank's credit strategies and policies.*

Preliminary evaluation to be made for selecting loan customers focuses at least on customer's reputation, financial situation, repayment performance in the past, morality of shareholders or partners if any, and the state of these features in view of bank's policies. Banks obtain sufficient information allowing the evaluation of the actual risk profile of the customer demanding the loan. Within the framework of customer due diligence, necessary preliminary examination is carried out about customers as per the related regulations.

Principle 12- *Intended loan use can either be stated by customers or be determined by the bank based on the needs of customers.*

Intended loan use is identified clearly. Banks try to ascertain whether or not personal loan demands are personal. Whether or not purchase & sales transaction is prearranged or fictitious is checked in vehicle and housing loan demands. Companies are provided with loans appropriate to their areas of activity.

Principle 13- *Banks establish predetermined evaluation and approval functions for an effective credit management. Loan approvals must comply with the written procedures of banks.*

The loan allocation process involves the evaluation and analysis of customer demands, preparation of loan offer, limit allocation/revision, term renewal, amendment in conditions of use, and revision of loan approvals. This process is managed by specialized and trained employees. Banks may establish a single-signature approval process, a double-signature approval process, or a committee approval process depending on the size and the nature of the loan in question. Procedures and principles concerning the approval process are established in written. They include the functioning of committees, too. Adequate transparency must be ensured in regard to the decisions made in the bank's loan approval process, and the final authority for approving the loan must be appointed. The board of directors

creates structures and practices that prevent shareholders, management, or other relevant parties from intervening in or putting the pressure on the functioning of the credit evaluation process.

Principle 14- *Banks must have adequate knowledge to make an accurate evaluation of the risk profile of the loan user or the counter party.*

Prudence is essential in the loan allocation process. Practices that may damage it are to be avoided in economic growth periods.

Banks form loan groups specialized in the analysis and approval of loan applications by sector, region, product group, or loan type. Banks evaluate risk-return relationship for each loan supplied to customers besides considering the total profitability obtained from the loan customer. Every loan offer is subject to a careful analysis by staff having adequate knowledge, experience, and specialization depending on the size and the complexity of the operation. Information and documentation to be needed in case of approving and renewing loans and amending the conditions of the contract must be included in the procedures by determining the minimum knowledge level and type to provide a basis for credit analysis. Banks get information at least about intended loan use, source of repayment, the risk profile of the loan user, his/her/its payment habits in the past, his potential repayment capacity, specialization of the loan user in the field of operation (for commercial loans), relevant sector and the standing of the loan applicant in the sector, and adequacy of collateral under various scenarios. Local conditions and requirements are taken into consideration in credit evaluation.

Principle 15- *Employees engaged in loan and customer evaluation must obtain accurate data.*

Credit evaluation requires a detailed analysis of the financial situation and the repayment capacity of the loan applicant based on accurate and updated information. When required, customers are visited, or information is obtained about them to reach the accurate information in the credit evaluation process.

Principle 16- *Banks must employ staff specialized in financial analysis to perform the financial analysis and intelligence works related to loans in the loaning process.*

Analysis of the company as well as evaluations on the sectors in which the company operates is included in the analysis report of a large-amount loan that is supplied over the amount determined by the bank. An attempt is made to collect information even in personal loans, which have numerous customers. Information works are performed at regular intervals in order for loan limits to be updated. Maximum sensitivity is displayed in information works when it is difficult to obtain comprehensive and sound financial data. In the event that any negative information is obtained about customers, mechanisms to allow timely updating of the intelligence data are established. Information notes regarding the visits to the companies with which the bank has a loan relationship are included in the relevant company's credit file.

Principle 17- *A customer's limit is determined based on indebtedness and repayment performance/capacity.*

The main purpose of credit evaluation is to analyze the customer's capacity to repay the loan he/she/it gets. Security, which is one of the basic loaning principles, is taken into consideration in loan allocations. The limit and the periodic payment amount of the customer are determined in his/her/its loan application based on his/her/its loans and limits in other banks. The sustainability of the income status of the customer is considered in determining his/her/its credit limit. Repayment capacity is measured prudently based on visible and predictable cash flows of the customer in the periods when principal and interest/profit share payments concerning the loan are to be made. Loan repayment schedule is established based on the customer's repayment capacity. The payment performance of the customer in the products he/she/it uses is examined as part of credit evaluation. Procedures that allow avoiding loaning the individuals that do not have adequate repayment capacity are established. The cash flow of the activity or investment that will be financed by the loan is

regarded as the primary source of repayment. Collaterals are not taken into consideration in evaluating the customer's repayment capacity.

Principle 18- C*ustomer's risk level must be evaluated.*

When determining the customer's risk level evaluations made by regulatory and supervisory authorities as well as independent auditing firms regarding loaning processes and specific loans are taken into account. The customer's risks in the bank and the bank's subsidiaries subject to consolidation are considered together. The loan applications of those customers whose debt-income balance exceeds the thresholds determined by the bank are evaluated more prudently. Risk evaluations concerning the loan applications of companies and risk evaluations concerning the personal loan applications of company shareholders are made together. Banks take into consideration the loan applicant's exposure to exchange rate, liquidity, and commodity risks in determining customer limits. The loan applications of those customers that have successfully passed the stress testing through such analyses and evaluations can be considered positive.

Principle 19- Information is obtained *about the causes of the loan need and the intended loan use through the analyses.*

Information is obtained about how the customer is to use the loan (what the customer will finance with the loan), and the necessity of the loan is evaluated based on the correctness of the intended use stated by the customer. In the event that it is concluded or detected in the evaluation of loan demands that intended use involves speculative operations or the indirect financing of high-risk operations that are outside the company's main area of activity, the actual intended use is taken as basis in credit evaluations. Meticulous attempts are made to provide companies with loans about their own areas of activity. Necessary measures are taken to prevent short-term loans from being used as permanent capital or for the financing of fixed assets. Measures are taken to prevent loan extension to company shareholders based on company limits without establishing any limit for these shareholders. It is confirmed in the loan extension stage that conditions of decision for allocation have been met.

Principle 20- *Project/specialized loans are evaluated by separate teams composed of specialized people.*

A separate team consisting of specialized people is established for project/specialized loans depending on the size of the bank. The reality of the expectations and projections regarding projects is examined. A reasonable lower limit is determined for the part of the project that is to be financed by the customer, and it is made sure that this limit is not reduced throughout the investment period of the project. It is confirmed that the part financed by the customer is met through the customer's own funds. Banks make decisions about long-term investments such as acquisition of subsidiaries or affiliate companies (including profit/loss participations in the case of participation banks) based on subordinated debts or debt instruments by making a detailed examination of all cash flows and risks expected from the investment and putting the analysis results in writing. Bridging loans or loans of similar nature extended prior to the beginning of the project and trenches released in the course of the project can be treated as a single loan provided that they do not differ from the forecasts in the contract and the project evaluation made at the beginning. In addition, measures are taken to make sure that loans of this nature are not used for repaying another loan, and cash flows concerning the project are transferred via the bank.

Principle 21- *Loan conditions are prepared in writing and in detail.*

Principle 22- *One of the most important elements of credit management is the establishment of credit limits at person/company level and at group level. Inspections for compliance with limits start in the credit evaluation process and are included in all loaning processes including the process of inspection of compliance with the legislation and in-bank regulations.*

The results of stress testing are used for establishing limits. Banks take necessary measures including information system infrastructure in order to ensure compliance with the limits indicated in the relevant legislation and in-bank

regulations and establish processes and practices that allow top management authorized for determining the limits to monitor the compliance.

Principle 23- C*ustomer's current financial position and credibility are taken as basis in renewing the loan.*

Extension of term and renewal that reduce the repayability of a loan are avoided. If a bank has problems in getting back the loan as the debtor is undergoing a temporary liquidity problem, it may restructure the loan or form a new repayment schedule for it in order to provide the debtor with liquidity power and ensure the collectibility of the loan. The loans of those companies whose activities have terminated or are likely to be terminated must not be restructured. Credit evaluation and credit allocation processes are implemented again in restructuring a loan. The fact that the debtor is undergoing a temporary liquidity problem is indicated through financial statements and relevant documents, and all the information and documentation regarding restructuring are included in the credit file of the debtor in detail. Collections other than those, which are through cash or cash equivalents, are avoided in restructuring a loan.

Principle 24- *Banks establish an internal rating system to manage credit risk. The rating system must be appropriate to the size of the bank.*

It should be made sure that the designed rating systems are actively used in loaning processes. The rating assigned to the customer in the loan approval stage is later reviewed on a regular basis. Reports taking the results of the rating systems as basis and giving information about the structure of the loan portfolio must be submitted to the bank's board of directors and top management on a regular basis. It should be confirmed that the system is compatible with the bank's loan portfolio and measures credibility at reasonable level by examining its consistency and functionality at specific intervals. When the rating system is deemed suitable for all the products that are exposed to credit risk, it must be established by taking into consideration economies of scale principles. Rating systems are supported with intelligence data and information based on market conditions. Banks with a complex

nature of activity are expected to use advanced computational methods in calculating the capital requirements. In rating models, those who are authorized to approve the model are determined; minimum score level is established; and accuracy and validity tests are carried out. Model awareness is raised among model users and model valuators. Validation studies are conducted for the internal rating models used by banks on a regular basis. The loan repayments of the individual customers to whom the loan has been allocated are followed up via behavior models. Rating systems measure potential and actual deteriorations in credit risk profiles so that changes in risk profiles can be detected in advance. It is made sure that company ratings remain updated by conducting rating in corporate loans at least once a year. Company rating and credibility are taken into consideration in limit increases. Necessary system infrastructure is established so that the rating system is used actively and efficiently in allocation processes. In consumer loans, the employed rating model is regarded as an important part of the loan approval process. Manual approval criteria are determined explicitly and discreetly. The loans approved through manual approval are kept at minimum.

Principle 25- *Banks may use collaterals and guarantees in order to reduce the risks that they are subjected to. The collaterals taken should not cause any weakness in making an effective evaluation of the customer.*

Principle 26- *Banks establish an effective credit follow-up process to manage the risks resulting from the loan portfolio.*

Principle 27- *Besides the developed model, stress tests and scenario analyses are used to measure and follow up the risks resulting from the loan portfolio.*

Principle 28- *Banks have written policies to manage uncollectibles. Loan follow-up and discharge processes are formed in such a way that collection efficiency is ensured.* [4]

1.4. INTELLIGENCE ABOUT THE BUSINESSES APPLYING FOR A LOAN

1.4.1. The Definition and Importance of Intelligence

The lexical meaning of intelligence is collecting information and receiving news. In banking, it refers to information collection from various sources and evaluation of such information by banks to correctly determine the moral and financial situations of persons or companies in confidence and objectivity in order to identify creditworthiness and mitigate the risk level.

Main purpose of intelligence is to minimize the credit risk. Thus, loan must be approved having reliable and efficient information. All the characteristics and financial position of a business must be uncovered for and intelligence gathering to be successful. Examination of data extracted from the Central Bank of the Republic of Turkey risk centralization center, lien-bankruptcy and protested bills, lien records, tax liabilities, and tender bans as well as interviews with the company's shareholders, on-site visits to the company, and news about the company in the printed and visual press help recognize the investigated company better.

1.4.2. Sources of Intelligence

1.4.2.1 Private sources: Business-based documents such as articles of association, financial statements, interviews with company officials and information obtained from them, relations of companies with other banks, company visits, certified public accountant reports, capacity reports, and progress documents.

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[4]https://www.bddk.org.tr/websitesi/turkce/Mevzuat/Duzenleme_Taslaklari/13054bankalarin_kredi_yonetimine_iliskin_rehber_taslagi_220414.pdf

1.4.2.2. Official sources: The records of the Central Bank of the Republic of Turkey, trade registry entries, Social Security Administration premium inquiry screen, lien-bankruptcy office records, tender ban screen of the Public Procurement Authority, and relevant laws and communiqués.

1.4.2.3. Semi-official sources: Public notaries, chambers of commerce and industry, associations of artisans and small traders, exporters' unions, chambers of engineers and architects, corporative enterprises, chambers of certified public accountants and chartered accountants, and stock exchanges.

1.4.3. Early Warning Signals Concerning Adversities in Companies' Financial Structures and Ability to Pay

Signs concerning whether or not there is any weakening in the financial strength of loan customers can be determined through the below-mentioned sources which have already been categorized in this study:

-The customer herself/himself,
-Market,
-In-bank account activities,
-Official institutions,
-Media,
-Other banks,
-Records of the Central Bank of the Republic of Turkey,
-The financial statements of the customer.

Main problems that can be encountered by loan customers are listed below:

1) Problems in the relations of the customer with the state:

-Non-paid social security contributions,
-Tax liabilities,

-Tax audits initiated in the business,

-Unpaid electricity, natural gas, and water bills,

-Tender bans and cancellations,

-License problems,

-Non-performed commitments, etc.

2) Problems in the relations of the customer with the market:

-Any negative information about the company obtained through market intelligence,

-Problems experienced by the company in collecting the receivables or paying the liabilities,

-Problems in purchase and/or sales conditions,

-Bounced checks and unfulfilled bills,

-Overcapacity in the sector,

-Domestic or foreign strong companies penetrating the market,

-Sales focusing on certain customers,

-Fall in the market share, etc.

3) Problems in the relations of the customer with the banks:

-Default records, signs of administrative or legal proceedings,

-Existence of indemnified non-cash liabilities,

-Banks freezing limits and initiating disclosure processes,

-Rapid decrease in the limit available in consolidated records,

-Fall in cash flows,

-Non-processed check and bond returns,

-Continuous lack of limit available,

-Indifference to credit costs,

-Increase in loan demands and in short-term loan usages,

-Bank loans converted to permanent capital,

-Risk transfers and loan demands for paying off a debt or a loan,

-Increase in factoring transactions,

-Working with many banks, etc.

4) Intra-company problems:

-Changes in the shareholder structure,

-Improper mergers,

-Falling behind technological developments,

-Managerial problems,

-Emergence of problems among managers and inefficient management,

-Wrong production, marketing, and planning policies,

-Events, which are annoying for employees,

-Shareholders not interested in business,

-Breach of contract,

-High turnover among managers,

-Risk concentration,

-Problems in the private lives of managers or shareholders,

-Unbalanced growth strategies,

-Dissolution in the company's area of activity,

-Inadequacy of production capacity,

-Loss of important customers,

-Acceptance of orders exceeding the capacity,

-Speculative purchases,

-Encumbrance, liens, bankruptcy orders, and orders of postponement of bankruptcy,

-Arrest of shareholders,

-Cancellation of certificate of authority,

-Investigations on the company or its shareholders,

-News against the company in media.

5) Financial problems:

-Successive periodic operating losses,

-Deterioration of the balance sheet items,

-Decrease in equity,

-Withdrawal of capital from the company by shareholders,

-Excessive changes in balance sheet items from period to period,

-Disruption of ratios,

-Financing of fixed assets by short-term liabilities,

-Negative annotations in the audit report,

-High-price sale of assets,

-Fall in sales,

-Increased costs,

-Excessive financial burden,

-Big amount exchange rate risks,

-Excessive borrowing,

-Late payments to the suppliers, etc.

It is clear that many sources can provide information about the security of the loan if the customers to whom the loan is supplied/is to be supplied are followed closely. If these information sources are utilized and necessary measures are taken timely, banks can collect their loan receivables timely and completely and avoid risky areas swiftly.

Early warning signals are not limited to the above-mentioned elements. Not every negative information obtained means that the loan will be problematic. Companies may establish mechanisms to correct the adversities they undergo. Detected problems must be evaluated on the basis of customers continuously based on the fact that every problem encountered may not pose a vital risk for the company, and the company may be capable of overcoming some problems. When it is thought that there are problems, the relevant departments of the bank should take measures in favor of the bank.

CHAPTER 2

2. LITERATURE REVIEW ON CREDIT RATING

Many researchers have used statistical methods to construct financial models. These models have been constructed to estimate financial difficulty, bond rating or credit rating of the companies and individuals. Among these methods, the prominent ones are as follows;

- Univariate statistical methods
- Multivariate statistical methods
- Artificial neural networks
- Optimization models

While some of these methods are used separately, some others are used together to compare the predictive performance of different methods. Some studies in which multivariate statistical methods are compared with artificial neural network models report that artificial neural network models have better predictive performance. However, Altman et al. (1994) state that artificial neural networks have an intuitive theoretical structure and identify relationships based on hidden correlations between variables. In addition, they argue that results in the comparative tests in their study revealed that artificial neural network models did not sufficiently improve the predictive performance of the models estimated by using multivariate statistical methods. Therefore, it was thought that logistic regression method, which does not contain such limitations as linearity and continuous data, which are experienced in the case of discriminant analysis, was more suitable for the present study. This is because; it was shown that discriminant analysis only allows classifying companies when it is used alone, and such classification does not provide any information about the risk of a company itself.

Credit rating models are developed not only for personal loans such as credit cards, consumer loans, housing loans, and auto loans but also for real sector loans including SME loans, commercial loans, and corporate loans. It is not possible to mention a model that yields the best result in every situation because datasets with different features are used in different situations. Thus, more than one model should be used as part of decision support system in order to increase accuracy rates in decisions.

The literature review shows that the concepts of "credit scoring" and "credit rating" are used interchangeably and have similar meanings. Both concepts are used for calculating the probability of default.

Many studies have been conducted on the evaluation of loan demands by banks both in Turkey and abroad. Topics included in these studies are loaning process in banks, credit risk, credit default risk, creditworthiness, and credit management. In credit evaluation, statistical techniques and econometric analyses are used for measuring the credit risk. This section addresses various studies dealing with the concept of "credit rating".

Charles Mervin (1942) examined financial ratios on bankrupt and non-bankrupt companies for periods of 6 months. He focused on 3 ratios: working capital to total assets, equity to total liabilities, and current ratio. It was concluded that working capital to total assets is better at bankruptcy prediction.

Beaver, William (1966) used a univariate logistic regression model (logit) to predict financial difficulty. It was determined that ratio analysis can be used for financial failure prediction until minimum 5 years ahead of the failure. Financial difficulty can be defined as a company's failure in its financial decisions. Beaver chose 30 financial ratios, divided them into 6 groups, and examined the credit risks of companies by sector. The only criticized point of the model is that it is univariate and takes into consideration only those ratios, which are related to a specific group of ratios.

2.1. THE ALTMAN Z-SCORE MODEL USED IN COMPANY RATING

Altman (1968) examined financially failing and non-failing companies in order to analyze and measure the validity of 5 standard ratios (liquidity, profitability, leverage, solvency, and activity). It was observed that ratio analyses were useful to predict financial failure in advance. Multiple discriminant analysis was chosen as statistical method. The most important characteristic of multiple discriminant analysis is that it allows the classification of the cases (failed and non-failed companies) based on multiple number of variables. Each group contained 33 companies in this model, which predicted whether or not the companies would go bankrupt by examining their financial positions based on financial ratios. The test proved that the model is successful at 95% confidence level.

Another discriminant model was estimated to predict the bankruptcy of the companies based on their financial data belonging to 2 years prior to the bankruptcy. Breakpoint or optimal Z value was used. A Z value of over 2.99 meant that the companies would not go bankrupt. A Z value of less than 1.81 meant that all the companies would go bankrupt. The range between 1.81 and 2.99 was called gray area.

It was concluded that proper and regular use of discriminant model might allow predicting financial problems related to the companies in advance and help avoid wrong decision. Some of the financial ratios used by Beaver were included in Altman's studies.

2.2. OTHER MODELS USED IN COMPANY RATINGS

As mentioned above, the literature contains more than one model measuring whether or not companies have possibility of going bankrupt and research in which these models are compared with one another. This section presents studies dealing with the success of methods such as decision support system, artificial neural networks, data mining, and corporate governance index in measuring the solvency of companies and personal loan users.

Meyer and Pifer (1970) established a financial failure prediction model. They carried out linear regression analysis by taking 0 and 1 (y=1; financial failure) as dependent variable.

Deakin (1972) both developed a model for predicting the bankruptcy of companies and evaluated the models constructed by Beaver and Altman. According to Deakin, although the technique used by Bever had high prediction performance, Altman's approach yielded better results.

Ohlson (1980) examined 105 bankrupt and 202 non-bankrupt companies on the basis of 9 financial ratios by forming three different bankruptcy models (i.e. one for one year before the bankruptcy; one for two years before the bankruptcy; and one for the combination of the two). The models proved to be successful in prediction by 96.12%, 95.55%, and 92.84% respectively. Like Beaver, Ohlson also used logit model.

Lancher et al. (1995) conducted a study to predict the bankruptcy of 282 companies by using the 5 financial ratios used by Altman. In the end, the artificial neural network model was found to be more successful than the discriminant analysis method.

Abdou et al. (2008) worked on a dataset of 581 personal loans, 433 of which were in good condition and 148 of which were in bad condition, originated by banks operating in Egypt and found out that the artificial neural network model was more successful than the discriminant analysis, the logistic regression analysis, and the probit analysis in terms of prediction performance.

Angelini, Tollo, and Roli (2008) worked on a dataset of loans originated by an Italian bank to small-sized enterprises and found out that the artificial neural network model had an average error rate of 7%.

İç and Yurdakul (2000) developed a credit evaluation model for banks. The model is based on qualitative and quantitative factors such as "subjective

creditworthiness, position of sector, and credit guarantees" together with the financial analysis principles indicated in the literature and used in practice. The model estimated indicates the overall credit scores. To this end, the method of analytic hierarchy process was used. In implementing the analytic hierarchy process, criteria, sub-criteria, and measurement criteria were classified hierarchically, and then overall credibility score was calculated. The main purpose of the model created based on the analytic hierarchy process is to accelerate the credit evaluation process and to make a correct and realistic evaluation. This model is based on financial ratios that measure profitability, financial structure, assets structure, and liquidity position as well as subjective factors such as creditworthiness, position of sector, and guarantees together. The analytic hierarchy process allowed using qualitative and quantitative values together and expressing them as a single result. The most critical point of the method is said to be that criteria are weighted by sector, and financial ratios of companies are converted to scores in the 0 to 1 range. It was highlighted that when the above-mentioned operations are performed by specialized people who are expert in their fields, have a good command of banking and other sectors, closely follow economic and social developments, easier and more productive usage can be achieved.

Aktaş et.al (2003) firstly developed financial failure prediction models by using experimental group data through multiple regression model, discriminant analysis, and logit model and then conducted validity tests on the developed models in order to predict financial failure. The research sample consisted of 106 enterprises, 53 of which had financial failure, and 53 of which did not have financial failure. A comparison of artificial neural networks and multidimensional statistical techniques was made in terms of predicting financial failure 1 year before it occurs. The study aimed to compare artificial neural networks and such statistical techniques as multiple regression analysis, discriminant analysis, and logit analysis, which are commonly used in financial failure research, in terms of prediction performance.

In all three models, it was determined, through the stepwise method, that 4 out of 23 financial ratios were statistically significant. These ratios are Liquidity Ratio, Short-Term Liabilities/Equity, Long-Term Liabilities/Total Assets, and Profit

for the Period/Equity. Factor analysis was performed in order to test the multicollinearity between financial ratios in a more clear way, and it was observed that 23 financial ratios could be explained by only 7 factors. Overall, the multiple regression analysis model, the linear discriminant model, and the logit model proved to be capable of making correct prediction by 89%, 87%, and 90% respectively. It can be said that the logit model predicted failing enterprises better than non-failing enterprises. This is important because; predicting failing enterprises incorrectly costs more than predicting non-failing enterprises incorrectly. The multiple regression model and the logit model were found to be more successful in prediction than the discriminant model.

The validity test results indicated that the multiple regression model was the best multivariate statistical model at predicting financial failure unbiased. Validity test was also performed for the artificial neural network model, too. The validity test results showed that the artificial neural network was better at predicting financial failure than the multiple regression model.

Tatlıdil et al. (2005) constructed a credit rating model for companies, which were potential commercial loan customers in evaluating the frequent loan demands and semi-structured decision problems in the banking sector. In the study, multivariate statistical analysis techniques were applied to the financial data of the companies. In addition, the usability of a knowledge-based decision support system having a knowledge base containing statistical analysis methods to provide decision support for company rating works was investigated. Attention was focused on DSS (Decision Support System) three-level rating system to enhance the quality of the loan decision to be made. To obtain the financial data of those companies whose shares are traded in Istanbul Stock Exchange (ISE), two main company groups were defined in the first place: (1) group 0 companies that were seen to have problems in repaying loans to banks in 2001; (2) group 1 companies that were not seen to have problems in repaying loans to banks in 2001.

Except for construction companies and financial sector companies, 12 "group 0" and 26 "group 1" companies were determined (i.e. 38 companies in total). Three-

level rating system was created for these companies. Overall, the analysis proved to be capable of making correct prediction by 94.7%. To make the analysis easier, the year-end financial data of the companies belonging to two years before the difficulty were used.

The variables used in analysis were liquidity ratio, leverage ratio, gross profit margin, financing expenses/net sales, operating profit margin, and company group (0, 1) (i.e. 6 variables in total). 38 companies were included in the analysis (i.e. 35 observations were made). Besides the linear discriminant analysis and the logistic regression analysis, knowledge-based decision support system method was applied to these data. It was argued that explanatory variables need to have multivariate normal distribution, and groups need to have common covariance so that the linear discriminant analysis is applied. Based on the ratings assigned to the companies, categories A, B, and C were created for the company groups. The **category A** included companies which had a positive financial structure and high creditworthiness; the **category B** included companies which had a lower creditworthiness in comparison to those included in the **category A,** but which could be provided with loan based on more detailed investigations and subjective evaluations to be made; and the **category C** included companies which did not have a positive financial structure at the date of investigation and should not be made a party of any credit relationship.

The study concluded that if decision support systems are used by the relevant departments of banks in the evaluation of loan demands, time and labor could be saved in finalizing the offers.

Altaş et al. (2005) aimed to develop a model to determine enterprises with financial failure risk. To this end, they used data belonging to textile industry enterprises listed in BIST (Borsa Istanbul [Istanbul Stock Exchange]). In the study, financial failure was defined as finishing the current period with loss. The enterprises' balance sheets belonging to the year 2001 were examined; their financial ratios were calculated; their period-end income statements were examined; and the enterprises were considered financially failed or financially successful for the related

period based on the results obtained from the above-mentioned examinations and actions. To determine the significant variables in the model, factor analysis was applied to the financial ratios in the first place. The obtained factor scores were taken as independent variables. Since homogeneity and normality assumptions were not fulfilled, the discriminant analysis was not possible. Thus, factors influential on financial failure were determined based on the logistic regression analysis results. Based on their usage in the evaluation of enterprises' operations, ratios were divided as follows: 5 liquidity ratios, 11 financial structure ratios, 9 activity ratios, and 8 profitability ratios. The calculated ratios were subjected to factor analysis. The obtained factor scores were taken as independent variables in the logistic regression. The analysis indicated that probability of making correct classification was 74.2%. It was concluded that liquidity ratio is the most important ratio in predicting financial failure, and this ratio makes significantly differentiate successful and failing companies.

Koh et al. (2006) focused on two issues: (1) using data mining in credit scoring; (2) creating a final scoring model by combining scoring models to apply this method (i.e. data mining). In creating the model, data related to 20 different variables obtained from a German Bank and qualitative factors based on customers' credit history and other characteristics were used. Out of 1000 customers, 70% were found to be "good", and 30% were found to be "bad". 3 techniques that were selected to be used in data mining are: logistic regression, artificial neural network, and decision tree model. It was concluded that the data mining method has gained much importance recently and is beneficial not only for creditors in terms of credit scoring but also for the business world.

Huang et al. (2007) tested artificial neural networks for financial and economic predictions. They also handled input variables concerning the artificial neural network model used in predicting foreign exchange rates, stock index, and economic growth indicators. The study concluded that while most of the inputs concerning the artificial neural network model used in determining foreign exchange rates were univariate, the inputs in the artificial neural network model used in determining stock index and economic growth were multivariate. The study also

compared the artificial neural network model and other performance models and indicated that the artificial neural network model yielded better results.

Vuran (2009) worked on a sample of 122 public and non-public enterprises for the 1997-2007 period. Two statistical methods were used in the study. Financial ratios that were useful for predicting enterprises' financial failures one or two years ahead of such failures occurred were determined. The discriminant analysis and the logistic regression analysis were applied in the study to make a comparison in terms of capability to prediction. The research results proved that most of the enterprises experiencing financial failure show financial difficulty indications in advance. In addition, no statistically significant difference was found between the methods used in the study in terms of capability to predict and selection of variables.

Chen, Huang et al. (2009) used a neura-fuzzy network model to predict the financial failures of companies. The analysis primarily focused on the factors of size, sector, and process. 100 financially failing companies were matched with 100 financially successful companies. Of the dataset, 70% was used for education, and 30% was used for testing. It was concluded that the neural-fuzzy network model is better at predicting financial failure than the logit model.

Akkoç et al. (2010) used artificial neural networks and linear discriminant analysis methods to develop credit rating models on the Turkish credit card dataset of an international bank and compared these metdods' performances of making correct predictions. The study contained 2,000 credit card customer data. Those customers who fulfilled their liabilities were included in the "good" credit group, and those customers who failed to fulfill their liabilities were included in the "bad" credit group. A numerical value of "0" was assigned to the good credit group while a numerical value of "1" was assigned to the bad credit group. Firstly, the linear discriminant analysis was applied to the dataset containing 22 independent variables through the stepwise method. The discriminant function was developed by using the independent variables with significant and high predictive power (i.e. capability to predict) among the above-mentioned variables. While 22 independent variables were used in the artificial neural network method, 9 independent variables were used in

the linear discriminant analysis. The linear discriminant analysis had a performance of 59%. The artificial neural network model's performance of making good prediction was 71%, and its performance of making bad prediction was 50%. It was concluded that artificial neural network models do not pose any problem resulting from ignoring the assumptions, which are found in statistical techniques such as the linear discriminant analysis.

Tükenmez et al. (2012) examined the financial data of 1500 small and medium-sized enterprises operating in the Aegean Region of Turkey. Two groups were created out of the examined companies. One of the groups contained 180 successful companies, and the other included 180 failing companies. The discriminant model, the logit model, and the CHAID method were used to predict financial failure. Then all these methods were compared in terms of prediction power. Net Sales/Total Assets was found to be the significant variable in both discriminant and logistic regression analyses. The acid-test ratio, on the other hand, was was to be a significant variable in logistic regression and CHAID methods. Interest Expenses/Net Sales was found to be a significant variable in all three methods. Although the discriminant analysis and the CHAID were seen to be close in terms of prediction power, the logistic regression method was found to be more successful than these two methods.

Budak and Erpolat (2012) used artificial neural networks and logistic regression analysis in predicting whether or not the customers demanding loan would have regular payment habits and aimed to ascertain these methods' prediction capacity. The logistic regression analysis, which divides loan customers into two classes (customers repaying regularly and customers not repaying regularly) is commonly used in practice. 1639 people who took out personal loan from a bank operating in the Turkish banking sector almost one year ago were included in the research sample randomly. Based on the loan repayments of these customers in the last one year, the customers were divided into two classes: (1) customers repaying regularly; (2) customers not repaying regularly. The dependent variable of the study was obtained in this way. The customers having a delay of 30 successive days in repaying loans in the last one year were included in the category "1", and the

customers not having a delay of 30 successive days in repaying loans in the last one year were included in the category "0". The logistic regression analysis calculates customers' probability of repaying their loans regularly. The customers whose probability was found to be over 0.5 were included in the class "not repaying regularly", and the customers whose probability was found to be less than 0.5 were included in the class "repaying regularly". The analysis results indicated that the artificial neural network model was capable of classifying correctly by 70.3%, and the logistic regression model was capable of classifying correctly by 65.1%. The artificial neural network model was found to be better at predicting credit risk than the logistic regression analysis.

Yakut et al. (2013) attempted to predict the financial distress of 140 industrial enterprises listed in IMKB (Istanbul Stock Exchange) between 2005 and 2008 through data mining and discriminant analysis methods and compared the effectiveness of these two methods. To this end, they firstly determined financially successful and failing enterprises and formed the sample, prediction set, and control set for statistical models to be developed. Then analysis was performed by using the above-mentioned methods. In performing analysis, financially successful and financially failing enterprises were determined based on the enterprises' balance sheets and income statements for the years 2008 and 2007 as Beaver (1966) took a year as a basis and made prediction until five years before, and Altman (1968) took a year as a basis and made prediction until one and two years before. After that, models were estimated by taking 2007 as a basis. The enterprises' success or failure situations were predicted based on the data from 2006 (i.e. one year ago) and from 2005 (i.e. two years ago). Next, the models were compared in terms of accuracy in classification. Criteria of financial success or financial failure were set to be "having gone bankrupt, de-listed in the stock exchange, having stopped operations, and having made loss minimum two successive years". 38 enterprises were found to be failing, and 102 enterprises were found to be successful. The successful enterprises were coded with "1", and the failing enterprises were coded with "0".

A model was developed on the experimental group consisting of 112 enterprises through data mining. It was found that the obtained model discriminated

the group with an accuracy of 98.21%. It predicted the control group composed of 28 enterprises with an accuracy of 89.29%. The variables of decision tree (firstly the most important one and then the others) were determined through data mining. Then financial success and financial failure predictions were estimated for the years 2006 and 2005. Stepwise method was used in the discriminant analysis model, and the financial ratios with multicollinearity were removed. As a result, there were only 4 financial ratios available out of 23 financial ratios. Financial success and financial failure predictions were estimated for the years 2006 and 2005 by using the obtained discriminant models. The study, which was carried out to predict enterprises' financial failures in advance, concluded that the data mining yielded better results than the discriminant analysis in predictions based on the data from 2005 and 2006.

Yıldız (2014) developed an Altman Z score model to predict the ratings of 35 companies included in BIST 100 index for the 2010-2013 period (i.e. to be called "investable" or "non-investable") through binary logistic regression by using corporate governance index besides the financial data. The analysis results indicated a significant relationship between the enterprises' investable positions and Altman Z score. No significant relationship was found between corporate governance index and investable positions, and thus the influence of the index on investable position could not be determined. These results show that financial data are still effective in company ratings, but corporate governance is not reflected in rating scores enough.

2.3. STUDIES ON BANKS' FINANCIAL FAILURE PREDICTIONS

Failures of companies have a negative effect on many institutions and organizations. Even though the success of companies is important for a country's economy to remain sound, the success of banks that collect deposits and originate loans is more important than that of companies. When banks fail, not only depositors but also financial institutions providing banks with funds and debtors also suffer. Thus, some studies on bank failures are presented here.

Benli (2005) developed financial failure prediction models based on logistic regression, which is one of the statistical techniques for predicting financial failures,

and artificial neural network model and compared the models in terms of capasity to predict financial failure. To this end, data related to 17 private-capital commercial banks transferred to the Saving Deposit Insurance Fund by the Banking Regulation and Supervision Agency in the 1997-2001 period and 21 private-capital commercial banks still continuing their operations were used. The artificial neural network model proved to have a prediction accuracy of 87% in classifying, and the logistic regression model proved to have a prediction accuracy of 84.2% in classifying. The artificial neural network model was able to predict successful companies with an accuracy of 82.4%, and the logistic regression model was able to predict such companies with an accuracy of 76.5%. The artificial neural network model was seen to be better at predicting financial failure than the logistic regression model. Therefore, it was concluded that the artificial neural network model could be used as a tool for predicting financial failure.

Kurtaran Çelik (2010) compared discriminant analysis and artificial neural network model in terms of prediction capacity. To this end, an attempt was made to predict 36 private-capital commercial banks' probability of failing financially 1 year and 2 years in advance separately by using the financial ratios of these commercial banks. 36 banks were included in the study. Of these banks, 18 were private-capital commercial banks transferred to the Saving Deposit Insurance Fund between 1997 and 2002, and 18 were successful private capital commercial banks continuing their operations normally. The criterion of failure was transfer to the Saving Deposit Insurance Fund. The starting year of failure was taken as the date of transfer to the Saving Deposit Insurance Fund. Since the models developed in the study aimed to predict failures 1 year and 2 years ahead of failure, the financial statements of the banks included in the study belonging to 1 year and 2 years before the year of financial failure were taken into consideration. In the study, the discriminant analysis model and the artificial neural network model were applied to the same sample, and an attempt was made to make predictions up to 2 years before the failure. Each year was evaluated separately. It was seen that the best prediction of successful banks and losing banks for 1 year before the failure was made by the artificial neural network model with an accuracy of 100% in prediction. As to 2 years before the failure, the best prediction of successful banks was made by the discriminant analysis model

with an accuracy of 88.9% in prediction. The best prediction of losing banks was made by the artificial neural network model with an accuracy of 100%. The discriminant analysis model had higher overall performance with an accuracy of 91.7% for 2 years before the failure. Because both methods used in the study displayed high performance, it can be said that these models can be used for predicting banks' financial failures.

Altunöz (2013) tested artificial neural network models with multiple statistical methods in predicting banks' failures in advance. The data used in the analyses were compiled from the web pages of the Saving Deposit Insurance Fund (TMSF), the Banking Regulation and Supervision Agency (BDDK), and The Banks Association of Turkey (TBB). Those banks, which were transferred to TMSF, were put in the category of failing banks. The date of failure was taken as the date of transfer to TMSF. Since the primary purpose was to predict bank failures 2 years before they occurred, the financial statements belonging to 1 year and 2 years before the year of financial failure were taken into consideration in both models. The dataset contained the 1997-2002 period, which was a period witnessing many bank failures. A total of 36 banks were analyzed. Failures were predicted 1 year before they occurred with an accuracy of 88%. They were predicted 2 years before they occurred with an accuracy of 77%. The artificial neural network model had a high level of success in prediction of failures both 1 year before and 2 years before they occurred.

CHAPTER 3

3. CREDIT SCORING MODELS, TECHNIQUES USED IN SCORING AND CREDIT EVALUATION PROCESS

3.1. THE FINANCIAL RATIOS USED IN THE STUDY

A sound credit scoring depends on the soundness of the financial data of a company besides an objective evaluation of it. Scoring models are used for calculating a company's probability of default and serve the purpose of classifying barrowers. In short, scoring makes a distinction between good and bad credit customers.

Evaluation of the companies is made on the basis of sectors in this study. Similar sectors are chosen to obtain results close to one another because of the importance of evaluating companies based on their sectors. 80 companies engaged in the sectors of **manufacturing**, **trade**, and **services** are evaluated based on their year-end financial data for the years 2011 and 2012. 23 financial ratios are used in evaluation. While percentage changes between two years are examined in some ratios, 2012 (i.e. the current year) was taken as basis in some other ratios. While the loan demands of 40 companies were accepted in accordance with their financial data, other 40 companies were rejected. The following financial ratios are used. The points to which the biggest attention was paid will be expressed in detail in the explanation of each ratio.

Liquidity can be measured by net working capital, which is calculated by subtracting current liabilities from current assets. However, the size of an enterprise needs to be known in order to be sure of whether or not the working capital calculated in this way is adequate for it. In this regard, the measurement of liquidity by ratios rather than net working capital may yield better results because it is difficult to make a comparison between enterprises due to different sizes that they have.

Ratios eliminate the effect of different sizes. Due to this reason, net working capital is not included in the financial data used.

The results reached through ratio analysis not only give information about the financial position of an enterprise in the previous year but also allow making a prediction about its future position. Thus, it can be said that the results of the analysis contribute to forward-looking decision-making processes.

The ratios used for measuring the performance of enterprises can be divided into four main categories: liquidity ratios, activity ratios, leverage ratios, and profitability ratios.

3.1.1. Liquidity Ratios:

In essence, liquidity ratios are used to measure the ability of an enterprise in paying its current liabilities and determining the adequacy of its working capital. *(Akgüç, 1984).*

3.1.1.1. Current ratio: Current ratio, which is also called banker's ratio because it was initially used by the banks to evaluate loan demands, is calculated by dividing current assets (i.e. economic resources which an enterprise can use to fulfill its short-term liabilities) by short-term liabilities.

The aim in calculating the current ratio is to measure the ability of a company to pay its short-term liabilities and to ascertain whether or not its net working capital is adequate. As a general rule, a current ratio of 1.5 can be deemed enough for developing countries including Turkey. However, this ratio is expected to be 2 in developed countries.

The current ratio varies from sector to sector. It is usually above 2 in the sectors that have large amount of inventories due to the length of their production processes. On the other hand, the current ratio is just over 1 in those enterprises which are engaged in transportation, public services, electricity production, and so

on. This ratio is likely to be lower than 2 in the enterprises which make production upon order, the enterprises which meet their financial needs through advance payments made by customers (i.e. the enterprises which work with advance payments for orders), and the enterprises which market the goods produced by other enterprises *(Akgüç, 2011)*.

Current Ratio = Current Assets / Short-Term Liabilities

3.1.1.2. Liquidity (Acid-Test) ratio: This ratio is calculated by dividing liquid assets and economic resources that can be converted into cash easily without any loss in value by short-term liabilities. In calculating the liquidity ratio, some adjustments need to be made on receivables. The acid-test ratio is lower among merchandising firms because these firms mostly work in rented places and thus the value of their fixed assets are usually lower. As a result, they have also low level of debt.

- If allowances include "allowance for doubtful receivables", such allowances need to be deducted from the amount of the receivables.
- Receivables backed by a promissory note (notes receivables) need to be evaluated by considering their realizable values and their face values must be discounted to reflect their realizable values as of the balance sheet date.
- Receivables from owners and/or shareholders must not be regarded as real receivables and so must be deducted from the amount of receivables in sole proprietorships, ordinary partnerships, and partnerships.
- If the advance payments made to sellers are included in receivables, such amounts need to be deducted from the amount of receivables.

A liquidity ratio of 1 can be deemed enough. Meeting this threshold shows that when the company converts its highly liquid assets into money, it can pay its short-term liabilities *(Akgüç, 2011)*.

Liquidity (Acid-Test) Ratio= (Current Assets - Inventories) / Short-Term Liabilities

3.1.1.3. Cash ratio: This ratio is calculated by dividing the amount of cash and marketable securities by short-term liabilities. It indicates the degree to what an enterprise can pay its short-term liabilities by using its most liquid assets in case of an extraordinary situation in which it can neither sell out its inventory and nor collect its receivables. A cash ratio of 0.2 is deemed sufficient in Turkey. But it is usually below 0.20 in Turkey. (http://notoku.com/oran-analizi)

Cash Ratio = (Cash + Marketable Securities) / Short-Term Liabilities

3.1.2. Leverage Ratios:

Leverage ratios are used for determining the indebtedness level of enterprises. When all other data are assumed to be equal, a high leverage ratio refers to a more risky enterprise because its payments of debt are fixed though its earnings are floating. As a result, if cash flow decreases excessively, the enterprise cannot pay its debts and technically goes into trouble *(KOLB R.W.-Ricardo J. RODRIGUEZ, ibid p. 35).*

3.1.2.1. Debt to equity ratio:

Debt to equity ratio shows the amount of an enterprise's debt as a proportion of its equity. It also indicates the amount liabilities that are used to finance the assets of the enterprise in proportion to its equity. Low debt to equity ratio is preferable. If enterprises can balance the trend in their debt to equity ratios and the business risks in their sectors with low operational risks, their working with higher debt to equity ratios is not considered unfavorable *(Özden, Başar, Kalkan, Istanbul University Faculty of Economics Econometrics and Statistics Journal, Issue:17, 2012, 23-44).*

Debt to Equity Ratio = Liabilities/Equity

3.1.2.2. Debt ratio:

This ratio shows the percentage of the assets of an enterprise financed by liabilities.[5]

Lower debt ratio refers to less problematic financial structure. Ratios below 50% are preferable.

Debt Ratio = Total Liabilities/Total Assets

3.1.2.3. Short-Term liabilities to assets ratio:

This ratio indicates the proportion of short-term liabilities used to finance the assets. Financing fixed-assets through short-term liabilities is considered to be risky. A general criterion for developing countries is a short-term liabilities to total assets ratio of less than 33%. A ratio of around 50% is considered favorable in inflationary countries and in those countries, which have difficulty in assessing long-term funds.[6]

3.1.2.4. Fixed assets to permanent capital ratio:

Those companies which wish to increase their activities need to increase their permanent capitals, especially the share of their long-term liabilities in their total liabilities. Because increase in activities necessitates investment in fixed assets and fixed assets should be financed through permanent capital.

Permanent capital is defined as an amount that is obtained by summing equity and long-term liabilities. It is calculated through dividing fixed assets by the sum of equity and liabilities. This ratio is expected to be less than 1. A ratio of more than one indicates that a portion of the fixed assets is financed through short-term

[5] Sedat Akyürek /işletmelerde performans analizi [performance analysis in enterprises]

[6] Barış Ilgaz, Oran Analizleri [Ratio Analyses]

liabilities, which is risky as stated above. An enterprise must firstly turn to its equity to fund its fixed assets or to increase its capacity. It must prefer long-term liabilities when its equity is not enough.[7]

3.1.2.5. Short-Term liabilities to net sales ratio:

This ratio shows the degree to what a company's sales are resistant to short-term liabilities. It is unfavorable that short-term liabilities are high, but net sales are low. Therefore, low short-term liabilities to net sales ratio is preferable for enterprises.[8]

3.1.3. Profitability Ratios:

The sole purpose of an enterprise is to make profit. Loss leads to a decrease in equity and causes it to disappear completely in the course of time. Alarm bells start to ring for any company that does not make enough profit for a long time even if it does not make a loss. A company's profitability is quite important in the evaluation of its medium-term and long-term loan demands *(Akgüç, 2011 p:282)*.

3.1.3.1. EBITDA (Earnings before interest, taxes, depreciation and amortization):

Profitability is the main criterion used for successfully evaluating the performance displayed by companies in their activities. EBITDA, on the other hand, is used to evaluate the profitability achieved by companies in their main areas of activity. This ratio allows making a more objective evaluation of the profitability of an enterprise by ignoring taxes, depreciation expense that does not require any cash outflow, and finance expenses. This ratio provides information about the ability of an

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[7] Akca, Nesrin, and Sinem Somunoğlu İkinci. "Ankara'da yer alan özel bir sağlık işletmesinin finansal tablolarinin oran analizi yöntemi ile değerlendirilmesi [the evaluation of financial statements of a private medical enterprise located in ankara through ratio analysis]" the journal of business science 2.1 (2014): 111-126.).

[8] Pur Hüseyin Pervuz, Muhasebe standartlari ve finansal tablolarin analizi [accounting standards and analysis of financial statements]

enterprise to fulfill its maturing liabilities. Banks pay attention to profitability in granting loans because it is thought that an enterprise, which has made a loss in more than one period, is likely to have difficulty in repaying the loan.

EBITDA = Operating Profit + Depreciation Expense+Amortization Expense

3.1.3.2. Gross profit margin: Gross profit margin shows the profit margin provided by the sales of a company in the current year regardless of its other incomes and expenses. Comparing the gross profit margin of a company with those of other companies in the same lines of business and/or those achieved in its previous periods may yield significant results. In this way, the profit margins of companies relative to other periods or to other similar companies in the same periods (i.e. their competitive powers and rises in their competitive powers by period) may be determined. The gross profit margin is determined by the price and the cost of the products sold so changes in these factors need to be monitored well. Rise in the gross profit margin can be considered favorable for a company.

There are some factors influencing the change of the gross profit margin. The factors listed below lead to a rise in the gross profit margin:

· Rise in sales prices despite steady costs,

· Fall in costs although there is no change in sales prices,

· Higher increase in sales prices in comparison to increase in costs,

· Faster decrease in costs in comparison to the decrease in sales prices,

· Increase in the shares of goods with high gross profit margin in the sales volume of the company as a result of the change in the composition of sales volume.

· Changes in the accounting practices of the company.

Gross Profit Marin= Gross Profit/Net Sales

3.1.3.3. Operating profit margin: We can also obtain information about the success of the managers in carrying out the operations efficiently and controlling the expenses

by calculating operating profit margin and comparing it with different periods and with those of different companies. Operating profitability is determined by factors such as the sales, investment, and operating policies of companies. Therefore, changes in these factors need to be monitored well. High operating profit margins are preferable for manufacturing corporations with a large capital. However, low profit margins are also significant for companies with a small capital.

This ratio reveals how profitable the main activities of a company. It is a positive development for a company that the operating profit margin is high and shows a tendency to rise.

The reasons for changes in this ratio by year can be as follows:

- Changes in sales prices,
- Changes in the costs of sales and/or general administrative expenses as well as selling expenses,
- Changes in the composition of sales.

Operating Profit Margin= Operating Profit/Net Sales

3.1.3.4. Net profit margin: Net profit for the period reflects the results of all activities of companies. The net profit margin is calculated by dividing the net profit for the period by net sales. Other incomes and expenses and finance expenses of a company are also taken into account in calculating the net profit margin. Thus, it is a ratio, which allows us to pass judgment on all operating, investment, and financing policies of companies. Comparing the net profit margin of a company with those of other companies in the same line of business and those achieved in the previous periods may yield significant results. This ratio gives information about the activities and the growth of the company.

In addition, developments in the net profit margin are particularly important for investors because dividend amounts to be paid are calculated and distributed

based on the net profit for the period. A high net profit margin means that the company is productive.

Net Profit Margin= Net Profit for the Period/Net Sales

3.1.4. Activity (Efficiency) Ratios:

3.1.4.1. Accounts receivable turnover:

Accounts receivable turnover shows the average collection period of receivables, a company's ability to collect its receivables, and the liquidity of receivables. The receivables of a company that can be collected in an appropriate time period can be regarded as highly liquid assets. If this ratio, which can be calculated through dividing the sum of total trade receivables (accounts receivables and note receivables) by net sales, is low, it means that the company has a high accounts receivable turnover. A high accounts receivable turnover shows that the company needs less financing for an activity volume of the same level (i.e. relatively less working capital tied to receivables). Thus, increase in accounts receivable turnover is usually favorable for a company. A low accounts receivable turnover, on the other hand, indicates that the company is extending excessive credit period, loses competitive power, has lack of an effective collection policy, is not capable of collecting some of its receivables at maturity, and so is likely to have doubtful receivables.

Accounts Receivable Turnover = Net Sales on Account / Average Trade Receivables

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Another indicator of accounts receivable management is average collection period. It shows the average number of days needed for the collection of the receivables of an enterprise. The higher is the accounts receivable turnover, the shorter is the average collection period. The lower is the accounts receivable turnover, the longer is the average collection period.

Average Collection Period = 365 / Accounts Receivable Turnover

3.1.4.2. Inventory turnover:

Inventory turnover shows how long it takes for the inventory to be converted into cash and how many times they are sold in a year. It is calculated by dividing the cost of goods sold on the income statement by average amount of inventory. A high inventory turnover indicates that less money is tied to inventory. In this case, the company has competitive ability.

Inventory Turnover= Cost of Goods Sold / Average Inventory

Average number of days inventory on hand is another indicator about inventory management as accounts receivables turnover is for accounts receivable management. The average number of days inventory on hand shows the average number of days when inventory stays in the enterprise. The higher is the inventory turnover, the smaller is the average number of days inventory on hand. The lower is the inventory turnover, the bigger is the number of days inventory on hand.

Average number of days inventory on hand = 365 / Inventory Turnover

3.1.4.3. Asset turnover:

Asset turnover shows net sales as a percentage of assets (i.e. the volume of sales generated from each TL [or any other currency] of investment in assets). A high asset turnover is favorable. Asset turnover is a measure of the efficiency of technology usage or asset utilization in a company. If fixed assets make up a

considerable amount of total assets, asset turnover turns out to be low. It is more common among capital-intensive manufacturing companies. On the other hand, this ratio is likely to be high in those enterprises, which have fewer fixed asset investments.

Asset Turnover = Net Sales / Average Total Assets

3.1.4.4. Cash conversion cycle:

Companies may not start investment by using cash when they are first founded. They may resort to trade credit for procurement of raw materials and other materials. Cash conversion cycle refers to the time in which the investment of a company converts into cash. The longer is the cash conversion cycle, the worse is the liquidity. The shorter is the cash conversion cycle, the better is the liquidity.[9]

Cash Conversion Cycle = Operating Cycle – Payables Conversion Period

Operating Cycle= Average Collection Period + Number of Days Inventory on Hand

3.1.5. Percentage Change Ratios:

The ratios used in the present study other than the above-mentioned 4 groups of ratios are listed as percentage change ratios. These ratios indicate the percentage change between the current year and the previous year.

3.1.5.1. Percentage change in tangible assets:

Tangible assets are carried on the balance sheet at their historic total costs. All sorts of expenditures made to acquire such assets are included in the total cost.

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[9] Melek Akgün, Maltepe University,Faculty of Economics and Administrative Sciences, Department of Business Administration,İşletmelerde etkinlik ve nakit çevirme süresi analizi [An analysis of cash conversion cycle and efficiency in enterprises]

Depreciation is calculated for tangible assets that are depreciated at the end of the accounting periods. In addition, necessary entries are made to reflect any decrease in amounts or values resulting from sale, transfer to any other department, loss, stealing, burning, breaking, breakdown, and so on. *(Erkan KARAARSLAN, Tahakkuk esasli devlet muhasebesinde maddi duran varlıkların kaydedilmesi [The entry of tangible fixed assets in accruals accounting in the public sector])*

3.1.5.2. Percentage change in net sales:

Increase in the net sales of a company year by year is favorable for the company's activities. Attention needs to be focused on percentage (%) change relative to previous years. Sales revenues and the amount of products or services sold need to be analyzed first in order to evaluate the change in net sales. Increase in sales revenues must be more than the inflation rate in the previous year. [10]

3.1.5.3. Percentage change in operating profit:

It is desirable that profit for the period mostly consists of operating profit so that it is considered sustainable and reliable. The operating profit is more important than ordinary profit in the evaluation of the company's management effectiveness. The biggest difference between the operating profit and the ordinary profit results from incomes and expenses from other operational activities. It is not favorable for a company that it does not make profit from its main activities, but turns to items such as interest revenue and foreign exchange gain.

Other percentage change ratios used in the analysis without detailed explanation here are Percentage Change in Profit or Loss for the Period and Percentage Change in Net Profit or Loss for the Period.

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[10] http://yvelioglu.blogcu.com/bir-isletmede-satis-performansinin-denetimi/1696450

3.2. DISCRIMINANT ANALYSIS

Discriminant analysis uses mathematical techniques to discriminate between groups. It is frequently used in financial failure studies. This analysis reveals whether or not there is a clear difference between two or more groups according to grouping variables.[11]

The foundations of the discriminant analysis were laid by Fisher in the 1930s. This analysis is one of the multivariate statistical methods used in the fields of biology, behavioral sciences, and finance. Both the business world and academicians use this method to evaluate consumer loans, determine successful and failed enterprises, and so on *(Öz, 2005:47)*. The discriminant analysis is widely used in the literature to determine and categorize the performance levels of companies in terms of many explanatory variables.

The discriminant model aims to ensure that variables are divided and go into their correct groups by minimizing the possibility of misclassification. Intention to divide variables with p number of known properties into groups based on these properties is of great importance for statistical evaluations for concrete summary information to be obtained. If there are p number of properties related to the variables, it is quite difficult and sometimes impossible to handle each one of these properties separately and to divide variables into categories. Thus, the discriminant analysis aims to convert a multivariate problem into a univariate problem.[12]

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[11] ÇELİK, Instructor Dr Melike KURTARAN. "Prediction of Financial Failure of Banks with Traditional and New Methods." Celal Bayar University Journal of Management and Economics 17.2 (2010): 129-143

[12] TÜKENMEZ, N. Mine, Erhan DEMİRELİ, and Göktuğ Cenk AKKAYA. "Finansal başarisizliğin tahminlenmesinde diskriminant analizi, lojistik regresyon ve chaid karar ağaci modellerinin karşilaştirilmasi: kobi'ler üzerine bir uygulama [The comparison of discriminant analysis, logistic regression, and chaid decision tree models for the prediction of financial failure: an application on smes]

The discriminant function can be expressed as follows:

$$Z_i = \beta_0 + \beta_1 X i_1 + \beta_2 X i_2 + \ldots + \beta_n X i_n$$

Z_i: discriminant value for the enterprise i,

β_0: constant term,

β_j: discriminant coefficients (j = 0, 1, …, n),

$X i_j$: the value of Xj property for the enterprise i (j = 1, 2, …, n).

The analysis of this data matrix, which has a dimension of 23*80 consisting of 23 variables and 80 companies (cases), aims to determine the influences of explanatory variables (X_i, i=1, 2, 3, …., n) on the dependent variable (Y) and to establish a functional relationship between explanatory variables and the dependent variable, thereby allowing prediction by means of the model estimated. [13]

In the analysis, the companies were put in the group "0" or "1" based on the evaluation results. While "group 1 (one)" refers to those companies which have no risk above normal for loan supply, have a positive financial structure, and have a high level of creditworthiness, "group 0 (zero)" includes those companies which do not have a positive financial structure (by the date of investigation) and so should not be made a party of any credit relationship.

3.3. LOGISTIC REGRESSION

The first studies in the field of logistic regression were performed by Berkson in 1944, 1953, and 1955. Logistic regression models are a special form of general linear models obtained for binomial distribution dependent variables (Agresti, 1996).

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[13] (Tatlıdil, Hüseyin, and Murat Özel. "Firma Derecelendirme Çalışmaları Konusunda Çok Değişkenli istatistiksel Analize Dayalı Karar Destek Sistemlerinin Kullanımı [The Use of Multivariate Statistical Analysis-Based Decision Support Systems in Company Rating Works" Bankacılar Dergisi [The Bankers' Journal] 1.54 (2005): 46-58.)

Logistic regression models are one of the most frequently used models in the prediction of financial failure. These models employ logistic cumulative density distribution rather than normal distribution. In other words, logit cumulative probability function or logistic regression function assumes that "U", which is the error term of linear probability function, displays cumulative logistic distribution. The equation describing the logit analysis is as follows:

$$P(x) = 1/ [1 + e^{-(b0+b1X1+b2X2+....+bnXn)}]$$

P(x): the company's probability of failure,

b_i: the coefficient of each independent variable

x_j: the value of each independent variable

Logit analysis started to be used in 1981 in order to avoid the presumptive limitations of the discriminant analysis. Logit model is another method used in the prediction of financial failure. It is used as a cumulative probability function in order to keep the value, which turns out to be between 0 and 1 in the discriminant analysis within this range.

Logistic regression analysis is preferable when the dependent variable is binary. It can be employed as an alternative approach to classification (Johnson and Wichern, 2002: p.641). This is because; logistic regression may yield much robust results when the assumptions of other statistical techniques that are planned to be used for planning cannot be met. Even if these assumptions are met, most researchers prefer logistic regression analysis because of its similarity to linear regression model (Hair et al., 1998: p.276; Tabachnick and Fidel, 1996: p.575). In linear regression technique, when the random variable Y that is used as a dependent variable is defined as the variable that gets the values 0 and 1, which indicate two categories, the following assumption is not fulfilled: the expected value of the error terms which are random variables is $E(\varepsilon) = 0$, and their variances are constant $Var(\varepsilon_i) = \sigma^2$. When there is a deviation from the assumption that error terms have a normal distribution, the estimators obtained through least-squares technique will not be the best, linear,

systematic, and error free estimators.[14] In addition, in such a case, even if the regression equation is obtained, hypothesis tests may not be made by the help of the normal distribution features of function parameters, and thus confidence limits may not be established (Özdinç, 1999: p.105).

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[14] Çakmak, Metin Baş-Doç Dr Zeki. "Gri İlişkisel Analiz ve Lojistik Regresyon Analizi ile İşletmelerde Finansal Başarısızlığın Belirlenmesi ve Bir Uygulama [Determining the Financial Failure in Enterprises Using Grey Relational Analysis and Logistic Regression Analysis & an Application]"

CHAPTER 4

ANALYSES

As the literature review (Chapter 2) reveals, multivariate statistical methods and neural network methods have been employed to develop financial prediction models. Since the main purpose of this thesis is to develop a financial model in order to predict the acceptability of the firm's loan applications, it is reasonable to use multivariate statistical methods and neural network methods. But neural network methods have certain shortcomings. Although the prediction power of these methods is higher as compared to that of multivariate statistical methods, neural network methods generally do not provide a model (an equation) to be used for future predictions. In other words, when a new case comes, the model must be estimated again by using all cases and variables. On the other hand, multivariate statistical methods provides a model with coefficients and when a new case comes only thing that must be done is to insert the value of the variables of that case (in our case financial data of a firm) and calculate the score. Then according to the score the membership (in our case approval or rejection of the loan application) is determined. It is also easy to interpret the models estimated by employing multivariate statistical methods. For these practicalities it is decided to employ multivariate statistical methods in this thesis. As for the multivariate statistical methods, we decided to use discriminant analysis and logistics regression (logit) because they are widely used methods for financial modelling in the literature.

In both methods, dependent variable is denoted as X1. X1 takes the value of 1 if the loan application of the firm was approved. X1 takes the value of 0 if the loan application of the firm was not approved. There are 80 cases (firms that applied for a loan). They are equally divided (40-40) as approved and disapproved. Of course, in reality numbers of applications approved and rejected are not equal to each other. Here, we take equal number of cases in order to avoid Type-2 error. Type-2 error is accepting the loan application of a business that should be rejected. Type-2 error is

more important, because it directly affects the amount of the non-performing loans, thus the assets quality. Independent variables are denoted X2 through X24. They are financial data calculated from the balance sheets and income statements of the firms' that were submitted to bank as an attachment to the loan application. Independent variables are presented in Table-1.

Table-1: Independent Variables

X2	Percentage change in net sales
X3	Percentage change in tangible assets
X4	Percentage change in net period income
X5	Percentage change in operating income
X6	Percentage change in period income
X7	Current ratio
X8	Acid-test ratio
X9	Cash ratio
X10	Average collection period
X11	Average number of days inventory on hand
X12	Payables conversion period
X13	Cash conversion cycle
X14	EBITDA
X15	Asset turnover
X16	Debt to equity ratio
X17	Gross profit margin
X18	Operating profit margin
X19	Net profit margin
X20	Debt ratio
X21	Short-term liabilities to assets ratio
X22	Short-term liabilities to net sales ratio
X23	Trade receivable to net sales ratio
X24	Fixed assets to permanent capital ratio

We must point out a very important issue at this point. In Turkey, firms submit to the banks the balance sheets and income statements that are submitted to the tax authority as an attachment to their tax returns when they apply for a loan. These financial statements must be prepared in accordance to tax regulations. But some firms make up their financial statements and distort the numbers on these statements for some purposes. It is the duty of the loan officer to detect and remove the makeup. The most common distortions are presented below:

-Inflate the expenses to reduce taxable income. A firm that applies for a loan does not do such a makeup for fear of disapproval. Because they are aware that a low income may result in the disapproval of the loan application.

-Distort the depreciation expense (calculate higher or lower depreciation expense than the correct amount). Distorting the depreciation expense causes the period income to be higher or lower. A firm that wants its loan application to be approved generally calculates the depression expense lower then it must be to inflate the income.

-Distort the amount of the bad debt expense and the corresponding allowance for doubtful accounts. Omitting the bad debt expense causes the net income to be lower; omitting the allowance for doubtful accounts causes the net receivables to be higher. Higher net receivables improve the liquidity ratios of the business.

-Classification distortions such as classifying a long-term receivable as current asset or classifying a short-term debt or short-term portion of long-term debt as long-term liability. This kind of distortions serves the same purpose, to improve the liquidity ratios.

-Omit a debt. Omitting a debt is a completeness distortion. Omitting a debt shows the leverage ratios better than they must be.

-Capitalizing financial expenses that must be expensed. Firms resort to this distortion to decrease their expenses and inflate their incomes.

When the firms apply for a loan they must submit the financial statements that was submitted to the tax authority as attachment to their tax returns. There is conflicting objective here. If they distort their financial statements to improve their incomes, they must pay higher tax. But a firm that needs a loan takes the risk of higher taxable income and distorts the financial statements accordingly. We must point out a very important issue. Accrued taxes are owed to the tax authority. But the firms may not pay the accrued taxes. If they do not pay the accrued taxes on time, interest is also accrued. Firms may choose not to pay the accrued taxes in expectation of a tax amnesty or a restructuring, which are common in Turkey. So, sometimes it is plausible for the firms to inflate the income to get a loan approval. As stated above loan officer make necessary corrections before processing the data on the financial statements. Of course, sometimes they may not be able to detect the distortions. In this thesis, financial data are calculated from corrected financial statements.

Discriminant analysis is the first multivariate statistical method applied. Because of the multicollinearity problem it was decided to use the stepwise method. One discriminant function is estimated. Wilks' lambda of the function is 0.730 and p-value is 0,001. These values indicate that the discriminant function obtained is significant at 99 % level. We can also say that the value of Wilks' lambda indicates that group means appear to be different.

Significant variables and their unstardardized coefficients are presented in Table-2.

Table-2: Significant Variables in Discriminant Anaysis

X16	0.001
X19	-0.067
X20	0.020
Constant	-1.709

According to model estimated, significant variables are debt to equity ratio, net profit margin, and debt ratio. Classification results of the discriminant model are presented in Table-3.

Table-3: Classification Results of the Discriminant Model

		Predicted Group Membership		Total
		0	1	
Count	0	31	9	40
	1	10	30	40
%	0	77.5	22.5	100
	1	25	75	100

76.3% of original grouped cases correctly classified.

As can be seen from Table-3 the discriminant model correctly classified 76.3 of the cases.

The second multivariate model applied is logit. Forward conditional method is used to eliminate multicollinearty and let the model enter the significant variables and remove the insignificant variables at each step.

Chi-square statistics obtained is 42.018 and significant at 99 % confidence level (p-value is 0.001). This result indicates that the model is significant and can discriminate the cases. Information related to the significant variables is presented in Table-4.

Table-4: Significant Variables in Logit Analysis

	Coefficient	Std. Error	p-Value	Significance
X2	-0.009	0.004	0.031	**
X19	0.433	0.161	0.007	*
X20	-0.064	0.021	0.003	*
Constant	5.411	1.861	0.004	*

* Significant at 1 % level, ** Significant at 5 % level

According to model estimated, significant variables are percentage change in net sales, net profit margin, and debt ratio. Classification results of the logit model are presented in Table-5.

Table-5: Classification Results of the Logit Model

Observed	Predicted		
	0	1	Percentage Correct
0	32	8	80
1	8	32	80
Overall percentage			80

The cut value is 0.5

Estimated logit model can be expressed as follows:

$$\frac{1}{1+e^{-(5.411+0.433X19-0.064X29)}}$$

As the value of the model approaches 0 the probability of rejection increases. As the value of the model approaches 1 the probability of acceptance increase.

As can be seen from Table 5, logit model correctly classified 80 % of the cases. The prediction power of logit model is higher as compared to the prediction power of

discriminant analysis. Logit model also produced more plausible results. For these reasons we will take logit model as our main model and present our interpretations based on the logit model.

When we examine the logit model we see that as the value of net profit margin increases the probability of loan approval increases. As the value of percentage change in net sales, and debt ratio increases the probability of loan disapproval increases. As can be seen from the results of the logit model the most important factors that discriminate the firms whose loan applications are approved from the firms whose loan applications are disapproved are profitability and leverage. Change in net sales is also a significant variable. But the sign of this variable is negative. It means that as the percentage change in net sales increases the probability of disapproval increases. This seems to be odd. But percentage change in net sales does not mean anything by itself. Also its effect is very low and its significance is not as good as the other significant variables.

Based on these results we will present the conclusions in the next chapter.

CONCLUSION

Banks are the main financial institutions in Turkey. Businesses mostly get their required funds from the banks by taking out a loan. Asset quality is one of the main factors that affects the performance of a bank and non-performing loans have direct impact on the asset quality. So it is of utmost importance for the banks to reduce the amount of the non-performing loans. Main procedure to reduce the amount of the non-performing loans is to evaluate the credibility (ability of a business to pay back the loan with interest) of the businesses that apply for a loan or a line of credit. This thesis attempts to contribute to credit evaluation (in other words credit rating) by developing multivariate statistical models. Two models are developed that are discriminant analysis and logistics regression (logit). The classification power of logit model is better than that of the discriminant analysis. That is why we based our conclusions on the logit model. Logit model has relaxed assumption and easy to interpret.

Both multivariate methods are classification models. They classify the cases based on the independent variables. In our study cases are the businesses that have applied for a loan or a line of credit. We grouped the cases into two groups as: businesses whose applications have been accepted and businesses whose applications have been rejected. So our dependent variable is binary taking the value of 1 if the application is accepted and 0 if the application is rejected. Independent variables are financial data (percentage changes and ratios). As result of the logit model estimated significant variables that have an impact of the acceptance or rejection of loan or line of credit application are found to be percentage change in net sales, net profit margin, and debt ratio. According to the model, as the value of net profit margin increases the probability of loan approval increases. As the value of percentage change in net sales, and debt ratio increases the probability of loan rejection increases. We will interpret these results based on the expectations and common belief.

First of all, we must point out that we were expecting the liquidity ratios to have an impact on the loan approval or rejection. This is also a common belief. But contrary to our expectations liquidity ratios are found to be insignificant variables in our model. At this point we have to point out that all liquidity ratios (current ratio, acid-test ratio, and cash ratio) are calculated by using balance sheet data. As it is known balance sheet shows the assets and liabilities of a business as a certain date, which is the balance sheet date. So, both assets and liabilities reflect the situation on the balance sheet day; they don't reflect the changes throughout the year. Another important point is that upon the approval of the application the bank establishes a credit limit for the business. So the banks have a long-term perspective. In other words when the banks establish the credit limits they expect to have a long-term relation with the business even if the business takes out a short-term loan. Another thing that must be mentioned is that most of the businesses take out installment loans whose maturities are usually more than a year. The last thing is that banks put more emphasis on liquidity ratios during the economic crisis periods. Because during the crisis periods banks have short-term vision and take into consideration the short-term payment ability of the businesses. The period under study is not a crisis period. For all of these reasons, we believe that the banks are not so concerned about the short-term liquidity of the businesses when they establish a credit limit.

We see that the most important factors that have an impact on loan (or credit) approval are net profit margin and debt ratio. Although the percentage change in net sales is also a significant variable its importance is not so high as compared to other two significant variables. Also as stated above, as the value of percentage change in net sales increases the probability of loan rejection increases. That seems to be odd. But percentage change in sales does not tell the whole story alone. This variable must be assessed thoroughly. Increase in net sales may stem from different reasons. This increase may be due to the increase in the volume of sales or it may be due to the increase in selling price. It may not be practical for the bank to go into such detail.

But net profit margin completes the story. Net profit margin has the biggest impact on the acceptance of a loan or line of credit approval. As stated in Chapter 3, net profit for the period reflects the results of all activities of a business. In this

regard, other incomes and expenses and finance expenses of a company are also taken into account in calculating the net profit margin. So this ratio reflects the performance of a business in all operating, investment, and financing activities. If a business is good at managing its sales, its pricing (in other words good at revenue creation), its investments, controlling its costs and expenses then it has a good profit margin. From this we can conclude that the first priority of the banks when they evaluate a loan application is the performance of a business in all its activities (operating, investing, and financing). If a business is capable of generating revenue from its activities, and controlling its costs and expenses then it has a good chance of getting a loan or a credit line approval from a bank.

The second important factor that the banks take into account when they decide a loan approval is the indebtness of a business. Banks are reluctant to extent a loan or a line of credit to the business that have high amount of debt.

We have to point out that only financial variables are used in this analysis. But the banks also take into account other factor when they evaluate the credibility of a business. These factors are business risk, management's integrity, economic conditions in the country and the expectations, political risks.

We all know that there are 5 Cs that are taken into account when assessing the credibility of a business. They are character, capacity, capital, conditions, and collateral. Statistical methods can only consider capacity (as measured by net profit margin) and capital (as measured by debt ratio). It is hard to quantify the other factors. But we should be aware of the importance of the other factors too. If the reputations of the owners and/or managers are not good, if the conditions are adverse, if the business does not have sufficient collateral, then the probability of a loan approval is low. On the other hand if the business cannot generate sufficient revenue from its all activities and if the business cannot control its costs and expenses, again there is a low probability that its application is approved. Likewise if the percentage of debt is high as compared to equity in financing the assets, again the probability of getting a loan approval is low. The most important contribution of this

study is to find proxies through multivariate statistical methods for capacity and capital, which are important factors in assessing the credibility of a business.

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