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## **AN EMPIRICAL INVESTIGATION ON CONSUMER CREDIT DEFAULT RISK**

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# **An Empirical Investigation on Consumer Credit Default Risk**

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## **Abstract**

This paper explores the relationship between consumer credit clients' payment performance i.e. credit default risk and some demographic and financial variables. Data to examine this relationship is obtained from the customer records of a private bank in Turkey. A logistic binary regression is used to evaluate the data. Financial variables rather than the demographic characteristics of clients have a significant influence on customers' pay back performance. Thus, the longer the maturity time, the higher the interest rate, and the higher the credit default risks. This suggests bankers apply appropriate adjustments to financial variables in order to minimize credit default risk.

## **Özet**

### **Tüketici Kredisi Borçlarının Ödenmesi Üzerine Ampirik Bir Çalışma**

Bu çalışmada tüketici kredisi almış müşterilerin kredi borçlarını geri ödeme performansları ile medeni durumları, yaşları, cinsiyetleri, meslekleri gibi demografik değişkenler ve gelir, anapara, faiz, vade, kredi tipi gibi finansal değişkenler arasındaki ilişki araştırılmaktadır. Bu amaçla kullanılan veriler Türkiye'nin önde gelen özel bankalarından biri tarafından tüketici kredisi almış müşteri raporlarından elde edilmiştir. Veri analizi için logistik binary regresyon kullanılmıştır. İstatistiksel analiz sonuçlarına göre finansal değişkenlerin müşterinin kredi borcu ödeme performansında etkili olduğu ortaya çıkmıştır. Buna göre, müşterilerine kredi sağlayan bankalar ve diğer finansal kuruluşların, vade ve faiz gibi finansal enstrümanlarda düzenleme yaparak risklerini minimuma indirmeleri mümkündür.

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## **Introduction**

During the last decade, importance of risk management in credit has increased for both borrowers and lenders, especially, in the developing countries. For this reason, banks and financial institutions started to revise their lending policies. There are basically six functional responsibilities associated with credit lending activities; (1) assessment of the customers credit risk, (2) making the credit granting decision with regard to credit terms and, where relevant, credit limits, (3) collecting receivables (debts) as the fall due and taking action against defaulters, (4) monitoring customer behavior and compiling management information, (5) bearing the risk of default or bad debt, (6) financing the investment in receivables (debtor) (Summer and Wilson, 2000).

This study deals with the fourth step of credit lending activities. Thus, the study focuses on collecting statistical data on consumer behavior, evaluating the collected data and trying to find managerial outcomes. These outcomes enable financial institutions to evaluate alternative lending policies and minimize their credit default risks and constitute the credit- scoring model<sup>1</sup> for some consumer credit types such as home loans, car loans, and individual support loans.

More specifically, this study aims to examine the relationship between the consumer credit clients' payment performance and some demographic variables (such as marital status, sex, age, residential status, occupation) and some financial variables (such as income, loan size, interest rate, maturity, credit category).

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<sup>1</sup> A statistical formula that is used, usually with the help of computers to estimate future performance of prospective borrowers and the existing customers. A scoring model calculates scores based on data such as information on a consumer's credit report ([www.fairisaac.com/servlet/SiteDriver/Content/934](http://www.fairisaac.com/servlet/SiteDriver/Content/934)).

The present paper is important for three reasons. First, many previous studies and financial institutions have focused on the relationship between lenders' decision and the characteristics of the consumer credit applicants rather than the relationship between payment performance of the consumer credit clients and their characteristics. It is, of course, important to get some information about the relationship between characteristics of people apply for consumer credit (applicants) and to whom the credit will be given. However, it is equally beneficial to have an idea about the relationship between the characteristics of people that are already accepted (clients) and whether they are paying back their loans on time or not i.e. payment performance. To some extent, the second is kind of testing whether the decision of accepting/rejecting (or the decision criteria) the applicants is the right one or not. Therefore, investigating the effects of some characteristics of credit clients on clients' payment performance becomes crucial. Second, by ranking customers according to predicted default probabilities, a bank will have a chance to minimize the expected default or misclassification rate subject to some exogenous acceptance rule (Carling et al., 1998). As a reaction to an increasing competition and bankruptcies, banks all over the world are trying hard to improve the process of loan origination in corporate banking. Practitioners estimate that improvements in risk management can decrease credit losses by 20 to 40%. Third, no research has been done on characteristics consumer credit applicants and/or clients of any Turkish financial institution in order to develop credit-scoring criteria for the banking sector in.

For the purpose of our study, we gathered the data on the characteristics of the credit clients of one of the biggest banks in Turkey. Decreasing the credit default risk is especially important for developing countries, since their financial environment is unstable. Turkish financial system is not only very unstable but also recognizes the

concept of credit in late 1988 in real sense. Thus, consumer credit is a new concept for Turkish financial market. In addition to insufficient credit granting mechanism, competition in Turkish credit market forces banks and financial institutions to make credit-granting decision really fast, usually in a day. Therefore, credit-scoring systems are trying to be adapted to Turkish banks and financial institutions that have been used in many developed countries since the 1980s. As a result of improvements in credit risk management, during the last decade, credit default rate decreased from 6% to 1.24%, whereas balance of consumer credit increased from TL 595.7 trillion to TL 3,678.9 trillion.

The following section gives a brief review of related research, then, the conceptual model used in this study followed by explanations on data, methodology, and statistical analysis used are presented. Finally, in the last section, conclusions and suggestions for further research are discussed.

### **Related Research**

The previous literature on consumer credit can be categorized in two parts; the studies on consumer credit applicants examining the lenders' decision to grant the loan and the studies on consumer credit clients examining the borrowers' ability to pay the loan. There are many studies on scrutinizing and improving the rejection and acceptance criteria of credit lenders' decisions. Jappelli (1990), for example, investigates lenders' and borrowers' behaviors in consumer rationing activities for the United States' credit market in 1983. He found that most of the applicants are rejected because of their credit history, their age or their income. Amount of collateral, which is a property, offered by borrowers to secure a loan in case of delinquency, is another important factor affecting credit-granting decision. Time spent at current job, time

spent at current address, job, type of work, family size, sex, and race is found to be less effective on credit decision.

Crook (1996) replicates Jappelli's (1990) study with 1989 data and examines whether the client characteristics, which predict the probability of households being credit constrained, have changed or remained the same between years 1983 and 1989 in the United States. According to his study, more years of schooling of a household head would also be expected to increase future income, with consequent increases in the household's demand for credit and the supply. Unlike Jappelli, he argued that having received more education enables a potential borrower to be more capable to forecast his/her payback ability, helping the decision of lender. There is tenuous evidence that the probability of default decreases with age. In the case of family size, there is clear evidence that the probability of default increases as the number of children increases. Roszbach K. and Jacobson T. (1998) built a statistical model in order to measure the risk of sample loan portfolio and show how the model helps to evaluate alternative lending policies. They found that income does not affect credit-granting decision and being a male significantly decreases the chance of being granted a loan. In addition, homeowners have more chance of being granted a loan. Although researches are mostly interested in evaluating the lenders' decisions on granting loans to credit applicants, the results of previous studies are contradictory.

Not many studies are done to investigate the relationship between characteristics of people that are already accepted (client) and whether they are paying back their loans on time or not. Carling K., Jacobson T., and Roszbach K (1998) examine the Swedish consumer credit clients' payment performance. According to their study, married applicants tend to pay back their loans faster. A possible reason might be the existence of two wage earners in the Swedish families, which leads to a stable flow of income.

Alternatively, it could reflect the fact that married couples is simply more diligent. Surprisingly, they found a negative relationship between incomes and default risk and the size of limit having no influence on payment performance, whereas increasing the loan size delay payback. Sexton D. E. (1977) analyzes the credit risk in two types of American families: (i) low-income families; (ii) high-income families. Aim of his study is to find out whether or not the variables associated with good credit risks among high-income families are similar to those for low-income families. His study does not analyze the extent of the impact of the independent variables on the dependent variable. However, its numerical results indicate that married couples and homeowners tend to pay their debt on time. On the other hand, credit default risk decreases when the income and age increase.

Different from these studies, the current study examines the effect of both demographic and financial variables on the payment performance of consumer credit clients of a bank in a developing country. The following section gives brief information about the empirical model used for this purpose. Then data and methodology used are explained followed by the results of the statistical analysis. Finally, in the last section, conclusions and suggestions for further research are discussed.

### **The Conceptual Model**

We constructed a conceptual model to explain the relationship between consumer credit clients' payment performance and credit category, interest rate, sex, age, marital status, income, loan size, maturity, residential status and occupation. The equation of the model is as follows:

$$\begin{aligned} \text{Payment performance} = & \beta_0 + \beta_1 \text{ Credit Type} + \beta_2 \text{ Interest} + \beta_3 \text{ Sex} + \beta_4 \text{ Age} \\ & + \beta_5 \text{ Marital Status} + \beta_6 \text{ Income} + \beta_7 \text{ Principal} + \beta_8 \text{ Number of Payments} \\ & + \beta_9 \text{ Residential Status} + \beta_{10} \text{ Occupation} + E \end{aligned} \quad (1)$$

## Hypotheses

The hypothesis for each independent variable to express our expectations about the relationship between each independent variable and the pay back performance i.e. whether the payment is on time or not, are explained below respectively:

*Hypothesis 1:* Intuitively, individual support loans are expected to have more credit delinquency risk. For this kind of loans, in case of default, there is no property can be mortgaged except collateral offering by the borrower. For this reason, these kinds of loans are sometimes fallen into arrears by borrowers.

*Hypothesis 2:* Intuitively, probability of credit delinquency increases when interest rate increases due to increases in payback amount.

*Hypothesis 3:* Intuitively, females have less credit delinquency risk due to their precautionary motives.

*Hypothesis 4:* Intuitively, older people have less credit delinquency risk due to their precautionary motives.

*Hypothesis 5:* According to Carling K., Jacobson T., and Roszbach K's study, married clients tend to pay back their loans faster. So we expect that married clients pay their installments on time.

*Hypothesis 6:* According to Carling K., Jacobson T., and Roszbach K's study, probability of credit delinquency increases when the income decreases. So, we expect to find a negative relationship between income and clients' payback performance, assuming there is no inflation.

*Hypothesis 7:* According to Carling K., Jacobson T., and Roszbach K's study, probability of credit delinquency increases when the loan size increases. So, we expect to find a positive relationship between loan size and clients' payback performance, assuming there is no inflation.

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<sup>2</sup> It is important to note that the dependent variable is a binary variable meaning that it has only two possible values payment on time or late, thus 0 or 1. The coding of independent discrete variables are available upon request from the authors.

*Hypothesis 8:* Intuitively, probability of credit delinquency increases when maturity increases because the longer term, the more probability of being missed installment because of forgetfulness and carelessness etc.

*Hypothesis 9:* Intuitively, homeowners have less credit delinquency risk than non-homeowners do because their houses are considered as a collateral, in case of delinquency. For this reason, homeowners try not to fall their credits into arrears.

*Hypothesis 10:* Intuitively, people working in private sector tend to pay back their loans on time more than others do since people working in private sectors are fixed income earners.

### **Data**

Data used to explain the relationship between credit loan payments and some financial and demographic variables were obtained through consumer credit records of one of the biggest Turkish private banks. In order to preserve confidentiality, client's personal information and name of bank are not given in this research. The dataset consists of 500 individuals from Istanbul who were granted a loan between the years 1999 and 2001. When monitored on January 15, 2001, the loans were either still paying regular installments and interest or had been amortized completely. Turkish Lira credits were selected because of fluctuation of currency rates and commission-oriented credits, which have low interest rate, were eliminated because of fluctuation of interest rates in order not to cause misleading results. Our data contains credits, which are repaid monthly with installments that are constant along the payback period.

### **Results**

Our dataset mostly contains on time paid loans (59 percent of the loans). Independent variables are grouped into two categories; demographic variables regarding the clients' characteristics such as age, income, marital status, residential

status, occupation and sex; and financial variables regarding the credit characteristics such as loan size, maturity, and credit type and interest rate.

For demographic variables, the average age of the clients is 43.5 (min. 19 and max. 68). Most of the banks and credit institutions must have preferred married couples because they are more dependable (69 percent of credit clients). 46 percent of the total clients are homeowners and 68 percent of credit clients are male. Most of the clients are working in private sector followed by workers, self-employed people, bankers, architects, and engineers.

For financial variables, a bank usually grants three types of credit: (i) car loans, (ii) home loans, (iii) individual support loans. The dataset mostly involves individual support loan, which is the most risky consumer credit due to the fact that there is no property can be mortgaged except collateral offering by the borrower. Lenders generally prefer giving this kind of credit for lower loan size and shorter maturity in order to decrease their risk. Rest of the data contains less risky credits such as car loans and home loans. In general, car loans and home loans are less expensive than individual support loans because mortgage on car and home decreases the credit risk. The average income is 830,938.40 TL. (min. 50,000,000 TL and max. 12,300,000,000 TL). Average loan size is 2,666,854,726.32 TL (min. 100,000,000 TL and max. 4,215,000,000 TL). Average maturity is 15.4 months that varies from 1 to 60 months. With the effect of inconsistent political and economic environment, 64 percent of the sample is short-term credit, payback period is less than 12 months. Interest rate changes from 2 to 9 percent related to type of credit, maturity, loan size, collateral etc., thus related to credit risk.

We examine the relationship between variables by looking at the correlation matrix presented in the appendix. By eliciting the correlation we also could determine whether we need to omit any of the variables because of multi-collinearities.

Correlations between credit category-interest rate, credit category-interest rate, credit category-marital status, credit category-age, credit category-income, credit category-loan size, credit category-maturity, credit category-residential status, interest rate-age, interest rate-loan size, interest rate-maturity, interest rate-occupation, sex-residential status, age-marital status age-income, age-loan size, age-residential status, marital status-maturity, marital status-residential status, marital status-occupation, income-loan size, income-residential status, loan size-maturity, loan size-residential status, residential status-occupation are found statistically significant at the 0.05 level. There is moderate positive correlation between income and loan size because of policy of the lending institution, thus, the amount of credit is determined according to borrowers income level. Another moderate positive correlation is found between age and income. This may indicate that older people earn more. Surprisingly there is a moderately negative correlation between interest rate and maturity. Negative correlation is found between age-residential status, credit category-age, credit category-income, credit category-loan size, and credit category-maturity, whereas the correlation between age-marital status, interest rate-age, and interest rate-credit category is found positive. No significant strong correlation is found to reveal a necessity to eliminate any variable and its individual component variables from the model.

As our final statistical analysis, a logistic binary regression<sup>3</sup> is used to determine the effect of financial and demographic variables on the payment performance of clients. The estimated change in the log of  $P(\text{Late Payment}) / P(\text{On Time})$ <sup>4</sup> computed for every value of every factor variables except reference values. First values of factor

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<sup>3</sup> A logistic binary regression is considered to be an adequate statistical method, since our dependent variable that is the payback performance of credit clients is a binary variable i.e. has a value of either 0 (on time payment) or 1 (late payment).

<sup>4</sup> P is the probability of event (late payment or payment on time).

variables kept constant when the others' coefficients are calculated. The results of the logistic binary regression is presented in Table 1.

**Table 1. Logistic Binary Regression Results**

| Independent Variable        | Coefficients<br>(p-values) |
|-----------------------------|----------------------------|
| Constant                    | -2.2865<br>(.001)          |
| Home Loan*                  | -.4455<br>(.472)           |
| Individual Support Loan*    | -.0837<br>(.795)           |
| Interest Rate               | -.0837<br>(.000)           |
| Sex (male is constant)      | -.1645<br>(.432)           |
| Age                         | .00677<br>(.556)           |
| Married**                   | -.2718<br>(.285)           |
| Divorced**                  | -.0796<br>(.893)           |
| Widowed**                   | .9578<br>(.335)            |
| Income                      | -2.234E-12<br>(.984)       |
| Principal                   | 3.9159E-11<br>(.243)       |
| Number of Payment           | .0274<br>(.047)            |
| Owner (with Credit Debt)*** | -1.086<br>(.321)           |
| Renter***                   | .3878<br>(.105)            |
| Family's Home***            | .4631<br>(.091)            |
| Company's House***          | .778<br>(.591)             |
| Occupation                  | -.01806<br>(.080)          |

Note that the reference levels for \*credit category is car loans, \*\*marital status is single, \*\*\*residential status is renter.

Deviance test has p-value that is less than 0.05 indicating that there is sufficient evidence for the model fitting the data adequately. In fact, According to p-values of each individual independent variable, credit category, sex, age, marital status, income, loan size are found statistically insignificant predictors. Residential status, however, is significant factor at the 0.10 levels. Thus, the clients' payment performance decreases, when clients live in their families' home. Although occupation seems to be an insignificant factor in our model, if the sample size increases and number of codes for occupation decreases, there may be a chance to interpret relationship between clients' payback performance and occupation more properly. Interest rate and maturity both positively affect the credit default risk, thus, the longer the maturity, the higher the interest, higher the risk for clients not paying their loans on time.

### **Conclusions And Suggestions For Further Research**

A bank that lends money to consumers faces two types of risk: (i) risk of default; (ii) risk of paying the loan earlier than the agreed time. The present study examines the probability of risk of default in terms of various financial and demographic variables and serves a useful function for creditworthiness. Our study is unique and important in many aspects. First because it examines the relationship between consumer credit clients' payment performance and their demographic characteristics whereas most previous research has been done on consumer credit applicants. In addition, we included financial variables additional to the demographic variables, while most of the previous studies done on clients' payment performance dwell upon only demographic variables. Second, our findings may enable banks and financial institutions to optimize their lending policies without changing their market

structure and potential clients. Third, this study is the first attempt to collect adequate information about how to decrease the credit default risk in order to develop credit-scoring criteria for the banking sector in Turkey.

Our empirical results indicate that financial variables rather than the demographic characteristics of clients have a significant influence on customers' payback performance. Thus, the longer the maturity time, the higher the interest rate, and the higher the credit default risks. This suggests bankers apply appropriate adjustments to financial variables in order to minimize credit default risk.

In order to understand the findings and interpretation of the results of this study better, one has to keep in mind the dynamism of the Turkish economic environment. At the end of the study in June 2001 Turkey has been announced as a risky country by S&P in terms of credibility, where as at the beginning of the study in January 2001 Turkey's credibility mark was B+. This unstable economy causes fluctuations in interest rates and currency rates, thus debtors' payback ability.

For further research, it is suggested that the sample size could be increased and number of codes for occupation could be decreased in order to have a better chance to interpret the relationship between clients' payback performance and occupation properly. In addition, payment performance could be measured as a continuous variable instead of a binary variable for a better investigation of the effects of the financial and demographic variables.

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## APPENDIX

|                       |              | Credit<br>Type AT | Interest<br>INT | Sex S | Age   | Marital<br>Status | Income<br>INC | Principal<br>RI | Number of<br>Payments<br>NOP | Residential<br>Status | Occupation<br>OCC |
|-----------------------|--------------|-------------------|-----------------|-------|-------|-------------------|---------------|-----------------|------------------------------|-----------------------|-------------------|
| Credit Type           | Pearson Corr | 1.000             | .216            | .064  | -.320 | -.180             | -.276         | -.373           | -.307                        | .170                  | -.016             |
|                       | P-Value      |                   | .000            | .151  | .000  | .000              | .000          | .000            | .000                         | .000                  | .717              |
| Interest              | Pearson Corr | .216              | 1.000           | .049  | .242  | .064              | .015          | -.105           | -.332                        | -.075                 | .133              |
|                       | P-Value      | .000              |                 | .273  | .000  | .153              | .741          | .019            | .000                         | .092                  | .003              |
| Sex                   | Pearson Corr | .064              | .049            | 1.000 | -.023 | .067              | -.048         | -.063           | -.087                        | .100                  | .,049             |
|                       | P-Value      | .151              | .273            |       | .604  | .134              | .283          | .157            | .051                         | .026                  | .279              |
| Age                   | Pearson Corr | -.320             | .242            | -.023 | 1.000 | .392              | .325          | .161            | -.029                        | -.371                 | -.014             |
|                       | P-Value      | .000              | .000            | .604  |       | .000              | .000          | .000            | .522                         | .000                  | .752              |
| Marital Status        | Pearson Corr | -.180             | .064            | .067  | .392  | 1.000             | .043          | .054            | .112                         | -.178                 | -.095             |
|                       | P-Value      | .000              | .153            | .134  | .000  |                   | .342          | .231            | .012                         | .000                  | .034              |
| Income                | Pearson Corr | -.276             | .015            | -.048 | .325  | .043              | 1.000         | .557            | -.019                        | -.140                 | .031              |
|                       | P-Value      | .000              | .741            | .283  | .000  | .342              |               | .000            | .679                         | .002                  | .484              |
| Principal             | Pearson Corr | -.373             | -.105           | -.063 | .161  | .054              | .557          | 1.000           | .254                         | -.151                 | .073              |
|                       | P-Value      | .000              | .019            | .157  | .000  | .231              | .000          |                 | .000                         | .001                  | .102              |
| Number of<br>Payments | Pearson Corr | -.307             | -.332           | -.087 | -.029 | .112              | -.019         | .254            | 1.000                        | .027                  | -.066             |
|                       | P-Value      | .000              | .000            | .051  | .522  | .012              | .679          | .000            |                              | .550                  | .140              |
| Residential<br>Status | Pearson Corr | .170              | -.075           | .100  | -.371 | -.178             | -.140         | -.151           | .027                         | 1.000                 | -.119             |
|                       | P-Value      | .000              | .092            | .026  | .000  | .000              | .002          | .001            | .550                         |                       | .008              |
| Occupation            | Pearson Corr | -.016             | .133            | -.049 | -.014 | -.095             | .031          | .073            | -.066                        | -.119                 | 1.000             |
|                       | P-Value      | .717              | .003            | .279  | .752  | .034              | .484          | .102            | .140                         | .008                  |                   |





