

# **An analysis and risk modeling on the mortgage loan defaults**

Omer L. Gebizlioglu , Belma Öztürkkal

Kadir Has University, Faculty of Economics Administrative and Social Sciences,  
Department of International Trade and Finance, Istanbul, Turkey

## **Abstract**

This paper presents an analysis of an emerging mortgage market and proposes a collective risk model for the non-performing mortgage loans. The empirical analysis is based on a large data set that consists of almost a hundred thousand records, over several years, with more than thirty variables in each. The summary statistics of the data are shown. A generalized linear model is performed to display the relation between the defaults of the mortgage loans and their borrowers. Then, a collective risk model is presented for the defaults in aggregate with a compound probability distribution deliberation. Some discussions are provided in sequel for the risk management implications.

## **1. Introduction**

Residential mortgages are in majority among the mortgage products all over the world. There are many studies on the residential mortgage markets that aim to investigate the mortgage defaults and the underlying causes for them. They mostly use loan-level data and employ linear or nonlinear parametric models to investigate the cause-effect relations and the relevant structural models. Quercia and Stegman (1992) gives a review of the literature on the residential mortgage defaults . We refer to Green and Shoven (1986), Deng and Gabriel (2006), Miles and Pillonca (2008), Mian and Sufi (2009), Dragon and Hong (2010), Goodman and Smith (2010), Demyanyk and Van Hemert (2011), Lin et al. (2011) and Magri and Picco (2011), as the studies that are relevant to this paper. One of the studies about the real estate market default rates, Von Furstenberg and Green (1974) studied a data of 7,609 mortgages from Federal Savings and Loan Insurance Corporation between 1961 and 1972. They report that delinquency rates are at peak in year four and increase with loan-to-value ratio at any time where increasing incomes have a negative effect on delinquency. Case and Shiller (1996) showed the relationship for the ratio between the value of mortgages and the market value of houses in a declining housing market to be associated with higher probability of mortgage default rates.

Real estate market is expected to be a safe investment, however periodically this market can be more speculative beyond one would rationally expect and the last bubble and sharp price movement was proven in the US sub-prime crisis. The securitization of these assets which were initially aimed to limit the risk of the loan providers actually transferred a higher than targeted risk to the holders of these securities. A vast amount of research is performed in this area. Shiller (2007) questioned the underlying reasons behind the boom creating a bubble in housing prices and referred to market psychology. Keys, Mukherjee, Seru, and Vig (2008) showed 20% increase in defaults for similar portfolios where portfolios were securitized due to lower screening of loans. Deng, Quigley and Van Order (2000) analyzed US Freddie Mac database between 1976 and 1983 and calculated risk of mortgages with option pricing mechanism where prepayment is a call option and default is put option. They showed unemployment rates and rate of the divorce have default consequences and found that higher loan-to-value ratio

resulted higher default as well. They note there is high level of heterogeneity between borrowers especially for prepayment which should be taken into consideration when forecasting defaults. Deng (1997) showed high unemployment and high loan-to-value ratio is linked positively to default of mortgages with the US Freddie Mac data.

The principle elements of a mortgage contract between a loan lender and a borrower are an obligation to perform debt payments and a pledge of a property to secure that obligation. There are several default factors for the mortgage loans that are characterized according to the peculiarities of the chosen interest rate and payment schemes, lending institutions, borrowers and the countries under concern. In that regard, a most common mortgage default is the failure to do installment payments of the principals and interests written on the promissory notes of the mortgage documents. Such failures on the side of the borrowers are the main causes for the acceleration of the debts and the unfortunate foreclosure actions. The interest rate types and payment schemes for the mortgage loans, pricing of the mortgages as financial instruments, and mortgage loan default risks are discussed in a wide perspective by Brueggeman and Fisher (2011).

Some studies link macroeconomic changes to default rates. Baxter and Lauria (2000) stated that employment reduction decreases the house values and thereby foreclosure rates which contributed especially to black homeowner's foreclosure rate's increase in New Orleans between 1980 and 1990. They report the existence of dual housing market for black and white population's housing market and where white populated housing prices declined black populated areas housing prices increased. Quigley (1987) studied a survey study for three consecutive years in 1979, 1980 and 1981 of 1,768, 1092 and 1,142 homeowners. In his research he showed the importance of the ownership on the mobility of homeowners and compared the results to changing interest rates and regulatory differences. Demyanyk and Hemert (2011) investigate the rise of the housing prices and uncontrolled rise of house mortgages with a data between 2001 and 2007 and the relationship of these factors to subprime crisis in 2007. The mortgages originated in 2006 and 2007 show higher delinquency rates. The study sheds light on the downward trend in the loan quality adjusting for individual and macroeconomic differences especially in the low-income areas which could have been detected earlier before the financial crisis. This was covered because of the high house prices at that time. Poterba (1991) presented data on large houses which appreciated the most in the 1970's and lost value the most in 1980's. The house price increase effect can be related to tax advantages of interest expense reduction. The decrease in demand in 1980's is related to the association of price reductions to future decrease in house prices. The study uses construction costs and land price for the explanation of the house price appreciation, where the significant positive association is found.

The focus of the empirical analysis in this paper is on an emerging market, Turkey. The data under the analysis belongs to one of the largest banks in this emerging mortgage market. In the data set, there are 97,771 records for the 2002 to 2011 period. The values in the data set are for variables that are about demographic, social and economic attributes of the borrowers, the loan contract contents and the mortgage loan payment default events. The analytical relation between the mortgage loan defaults, contract contents and the borrower's attributes are modeled by the logistic regression type generalized linear models where the frequency of the mortgage defaults are expressed in terms of binomial random variables.

The empirical analyses reveal that the residential mortgage payment defaults relate to two basic likelihoods. One is the likelihood that a mortgage loan borrower's income may decline after a loan is made, and the other is the likelihood that the value of the property under concern may fall below the loan balance in a future time. In either case a loss occurs for the lending institutions. In this connection,

following the logistic regression analysis, the paper presents an aggregate loss probability model that contains the compounding probability distributions of frequency and severity of default losses in a given period of time.

The paper unfolds into three following sections. The next section presents the data, the linear models and their results. In the third section, the loss process and the aggregate loss probability model for the mortgage payment defaults are derived. Therein, the mean and variance expressions are derived and some interpretations are provided.

## **2. Empirical Analysis on Mortgage Loans**

One of the major private banks in the private sector provided the mortgage loan data. The bank is ranked as fifth largest bank among all and one of the four private banks in terms of total assets by Turkish Banking Association as of March 2012. The bank has 14,966 employees and 908 branches.

The mortgage loans market in Turkey, as of end of 2011, reached 1,280,066 loan takers and the loan amount reached 69,755 million Turkish Lira, with an average loan size of 54,500 Turkish Lira. The non-performing loans amount is 2% for the mortgage loans combined with the consumer loans.

### **2.1. The Data and Descriptive Analysis**

In this paper the mortgage loan data from one of the major private banks in this emerging market have not been used by any other academic study and this is the first study with such rich information in this market. The data represents about 8% of this major emerging market at a period where market volatility varied due to the major global economic crisis. The information provided by the bank for the customers' outstanding loan portfolio is for the period January 15<sup>th</sup> 2002 and March 31<sup>st</sup> 2011. In our database there are 97,771 customers with mortgage loans. Out of this large sample demographic information for 84,693 customers are available. Detailed description of the mortgage data shows that there are 6,930,922,056 TL worth mortgage loans and 3,222,170,239 TL in real terms generated by the bank between the period 2002 and 2011.

Turkish mortgage market is developed faster after 2007 after the Mortgage Law passed through the parliament on the date of March 6, 2007.

There was a change in regulation and the previous ability of loan takers to get mortgage loans in foreign currencies is restricted. The loan takers cannot obtain loans unless they provide 25% of the asset value in cash at the initiation period of the loan. <sup>1</sup>

The loans are provided mainly in Turkish Lira and 95.4% of the total loans in our dataset are in local currency. 2% is in US Dollars, 1% in Euro and 1% in Swiss Francs. There are 923 foreign exchange denominated loans out of total 97,771 loans and the foreign currency denominated loan amount is 242,446,084 (3.6%) in TL terms.

The data analysis report shows the ratio of the non-performing loans to total loans as 0.6% and the average amount of loans is 70,889 TL. The 78% of the customers who receive mortgage loans from the bank are male. 78% of the people who ask for mortgage loan are married. They are 41 years old in average with minimum 18 years of age and maximum 84 years of age. 3.8% of the people who ask for mortgage loan have jobs in finance sector and 0.8% are executives.

---

<sup>1</sup> [Give detailed information reference](#)

We define a job in finance sector as banking, accounting, brokerage, insurance sector profession and other finance sector profession. We classify the customers as executives if they have a responsibility as general manager, they are member of the board or they are owner of a large firm. The mortgage loan business started only in 2005 and the pickup is in year 2009 onwards with the interest rates in Turkey decreased from nominal 75% in 2002 to 10% in 2011.

In the data set provided by the bank, 31% of the mortgage loans are generated by the customers who have their accounts opened in İstanbul, 15% by the customers from Ankara and 5% by the customers from İzmir. The education level of the loan takers are high, where 18% have elementary school level education, 33% high school education, 25% college education and 8% have graduate education. Table 1 Panel A reports the summary statistics between 2002-2011 as a whole and for the defaulted loans yearly numbers in mean, minimum and maximum. Table 1 Panel B reports the summary statistics for all years 2002-2011 seperately. The non-performing loans amount to 0.6% of the total loans and there are 559 defaults on Turkish Lira loans and 6 defaults in foreign exchange loans. The average amount of defaulted loans is 78,503 TL. The 80% of the customers who defaulted are male which is about the same level of the rate of male loan takers. 77% of the people who defaulted on the mortgage loan are married. They are 42 years old in average with minimum 18 years of age and maximum 67 years of age.

[Table 1 around here]

The immediate meanings of the obtained estimations about the features of the mortgage defaults are as follows: There is no default of total loans (any TL or foreign exchange denominated loan) where the mortgage owner is business owner or board member. Additionally, no broker job, no insurance sector job or no business administration or economics profession has defaulted loan. All finance related job has lower default rate, 3.2% of the people who defaulted on mortgage loan have jobs in finance sector and 1.2% are executives. Master and Phd degree holders have 3% default rate out of total defaults, college degree holders 18%, high school degree holders 43% and elementary school degree has 18% default rate out of total defaults. Education seems to pay off since the default rates for college and graduate degree holders are lower than the total loan percentage levels. The loans are generated 32% from İstanbul, 11% from Ankara and 5% from İzmir. Default in Ankara is lower than the generated loan percentages.

There is no default of any foreign exchange denominated loan where the mortgage owner has a job in a bank, has an accounting related job, is a broker, is in insurance sector, has a job in other financial institutions.

There is no default of any foreign exchange denominated loan, where the mortgage owner is an owner of a business or board member or has any executive job. The loan-taker of defaulted foreign exchange mortgage loans are all male, 50% high school graduates and received the loan in 2008. Minimum installment is 120 months and maximum is 180 months (mean=140).

It is a matter of interest for the analysis in this study that the parameters of the linear statistical models estimated may have meanings for each of the individual years within the concerned data. Therefore, a random parameter linear model is constructed and interpretations of the model are presented with attention due to the manner that the parameters assume values through a chain of consecutive years.

Table 2 shows a comparison of real and nominal mortgages and defaulted mortgages. The loans generated in years 2007 and 2008 have increased default rates. The default rate of the mortgages increased before the unemployment rate showed an increase later. The default rate on the mortgages was at the peak for the loans generated in 2008, where the default rate changed between 0.1% and 1.8%.

[Table 2 around here]

## **2.2. Analysis by Linear Models**

The statistical description and analytical depiction of the relations between mortgage loans and the concerned default elements are worked out by using generalized linear statistical models, such as logistic regression, that allow the presence of continuous, discrete, qualitative and order valued variables in the models.

Some of the obtained results are mentioned below as the logit response outcomes of a logistic model. Following this model, a detailed picture of relations among and between the adopted factors and variables are provided by a regression.

## **2.3. The Results and Discussions**

Table 3 below reports a binary logit response for the non-performing loan dummy. The principal loan amount in TL is adjusted by the consumer price index reported by TUIK and real loan amount is used in the analysis. The principal, number of installments, being male are positively related to default and significant. Year of the loan generated, being from Ankara and being from İzmir are negatively related to default and significant.

[Table 3 around here]

Furthermore, Table 4 shows the stepwise regression estimation for the non-performing loans dependent variable which is the principal loan amount calculated in real TL values. The variables that are used as independent variables are logarithm of age, gender, marital status, being from Istanbul, being from Ankara and being from İzmir, being employed in a bank, being employed in accounting sector, being a CPA or equivalent, being a broker, being in the insurance sector, having a job in business administrator or economist, being employed in other financial sector, being a general manager, being an owner, being a member of the board, logarithm of the real value of the remaining loan in TL, having a masters or above degree, having a college education, having a high school education and the year the loan is generated.

Remaining loan in real TL value, being from Istanbul, having a high school degree and college degree are positively related to principal amount in TL and is significant. Being form finance related job other than economics, business administration, insurance, accounting, banking and brokerage is also positively related to principal value but this is not significant at 10% or less. Year of the loan generated and the number of installments are negatively related to principal amount in TL and is significant.

[Table 4 around here]

The stepwise regression had seven steps and the variables with 15% significance are left in the model. The remaining model has being from Istanbul, logarithm of the real value of the remaining loan in TL, having a college education as independent variables. The model has Rsquare 79.6%.

### 3. Default Risk Modeling

The mortgage loan default risk modeling for the payment failures has two compounds; number and severity of defaulted mortgages in certain time periods. In this connection, a parametric aggregate risk model for the collective mortgage assets portfolios is introduced here. The underlying probability distribution and the first two moments of it are also derived for the model.

The empirical analysis of the previous section reveals that over a period of  $m$  years,  $m=1,2,\dots$ , there may be random and independent occurrences of failures in the obligations of the prefixed mortgage installments of the loan takers in the non-overlapping time intervals  $t_i \equiv [t_{i-1}, t_i)$ ,  $i=1,2,\dots,m$ . A loss then is realized for each defaulted mortgage due to the impairing effects of the failures on the predetermined cash flows of the concerned installment payments. Let  $N_i$  be the number of random failures in time interval  $t_i$  and let  $N(i) = N_1 + N_2 + \dots + N_i$  denote the cumulative sum of the failures up to the end of the time interval  $t_i$ . Further, let  $Y_j$  denote the random loss or amount, or severity, due to the  $j$ -th failure such that the aggregate loss amount  $S(i) = \sum_{j=1}^{N(i)} Y_j$  accounts for the cumulative random sum of the losses in the time span of  $[t_1, t_i)$ . Then there are two cumulative processes under the concern; the count process  $\{N(i)\}$  and the loss process  $\{S(i)\}$ .

### 4. Conclusion

The mortgage loans developed in the last decade in Turkey and the growth rate of the loans is enormous. Previous real estate bubble experiences in the mortgages can be an issue for the future of this emerging market. The analysis shows that the mortgage default rates have increased for the loans originated at the financial crisis years of 2007 and 2008. Although the data used in this analysis is restricted, the study of the mortgage data in this market sheds light to future problem areas and may enable the prevention of them. This analysis tries to relate the loan default to different loan characteristics and finds that the non-performing loans are significantly and positively related to principal in TL, the number of installments and to being male. The default rates are decreasing as the year of the loan increases as one may expect since the recent loans may not have had enough time elapsed to see any delay in payments. Being from second and third major cities, Ankara and İzmir decreases the risk of default significantly.

Our data has no information of the loan-to-value therefore the finding is limited. We also do not have information about the default dates. As there is not any information about house price appreciation the private mortgage data was not evaluated for the changes in housing prices at the time when unemployment rates increased.

The study can report patterns if the default dates of the mortgage loans and loan-to-value rates can be obtained in the future.

### 5. References

- Bastos, J.A., 2010. Forecasting bank loans loss-given-default, *Journal of Banking and Finance*, 34, 2510-2517.
- Brueggeman, W.B., Fisher, J.W., 2011. *Real Estate Finance and Investments*, fourteenth ed. McGraw-Hill, New York.
- Case, Karl E., and Shiller, Robert J. 1996. Mortgage Default Risk and Real Estate Prices: The Uses of Index-Based Futures and Options in Real Estate. *Journal of Housing Research* 7(2):243–58.
- Deng, Yongheng. 1997. Mortgage Termination: An Empirical Hazard Model with Stochastic Term Structure. *Journal of Real Estate Finance and Economics* 14(3): 309–331.
- Deng, Yongheng., Quigley, John M., and Van Order, Robert A. 2000. Mortgage Terminations, Heterogeneity and the Exercise of Mortgage Options. *Econometrica* 68(2):275–308.
- Demyanyk, Y, Van Hemert, O., 2011. Understanding the subprime mortgage crisis, *Review of Financial Studies*, 24, 1848-1880.
- Deng, Y., Gabriel, S., 2006. Risk-based pricing and the enhancement of mortgage credit availability among underserved and higher credit-risk populations, *Journal of Money, Credit and Banking*, 38, 1431-1460.
- Dragon, Y., Hong, Y., 2010. Market conditions, default risk and credit spreads, *Journal of Banking and Finance*, 34, 743-753, 2010.
- Fisz, M., 1963. *Probability Theory and Mathematical Statistics*, third ed. John Wiley and Sons, New York.
- Goodman, A. C., Smith, B.C., 2010. Residential mortgage default: Theory works and so does policy, *Journal of Housing Economics*, 19, 280-294.
- Green, J., Shoven, J. B., 1986. The effects of interest rates on mortgage prepayments, *Journal of Money, Credit and Banking*, 18, 41-59.
- Kemaloglu, S.A., Gebizlioglu, O.L., 2009. Risk analysis under progressive type II censoring with binomial claim numbers”, *Journal of Computational and Applied Mathematics*, 233, 61-72.
- Keys, Benjamin J., Mukherjee, Tanmoy., Seru, Amit., and Vig, Vikrant. 2008. Did Securitization Lead to Lax Screening? Evidence From Subprime Loans. *Working Paper*
- Lin, C-C., Prather, L.J., Chu, T-H., Tsat, J-T., 2013. Differential default risk among traditional and non-traditional mortgage products and capital adequacy standards, *International Review of Financial Analysis*, <http://dx.doi.org/10.1016/J.irfa.2012.11.005>
- Lin, T.T., Lee, C-C., Chen, C-H., 2011. Impacts of borrower’s attributes, loan contract contents, and collateral characteristics on mortgage loan default, *The Service Industries Journal*, 31, 1385-1404.
- Magri, S., Pico, R., 2011. The rise of risk based pricing of mortgage interest rates in Italy, *Journal of Banking and Finance*, 35, 1277-1290.
- McCullagh, J.A., Nelders, J.A., 1989. *Generalized Linear Models*, second ed. Chapman and Hall, New York.
- Melnikov, A., 2004. *Risk Analysis in Finance and Insurance*. Chapman and Hall/CRC, New York
- Mian, A. and Sufi, A., 2009. The consequences of mortgage credit expansion: Evidence from the U.S. mortgage default crisis. *The Quarterly Journal of Economics*, 124, 1449-1496.

Miles, D., Pillonca, V., 2008. Financial innovations and European housing and mortgage markets, *Oxford Review of Economics*, 25, 145-175.

Poterba, James M., *Brookings Papers on Economic Activity* 2:1991.

Rolski, T., Schmidli, H., Schmidt, V., Teugels, J., 1999. *Stochastic Processes for Insurance and Finance*. John Wiley and Sons, New York.

Qi, M., Yang, X., 2009. Loss given default of high loan-to-value residential mortgages, *Journal of Banking and Finance*, 33, 788-799.

Quercia, R. G., Stegman, M. A., 1992. Residential mortgage default: A Review of the literature. *Journal of Housing Research*, 3, 341-379.

Shiller, Robert J. 2007. Understanding Recent Trends in House Prices and Home Ownership. *NBER Working Paper* No:13553.

Tsai, M-S., Liao, S-L., Chiang, S-L., 2009. Analyzing yield, duration and convexity of mortgage loans under prepayment and default risks, *Journal of Housing Economics*, 18, 92-103.

Von Furstenberg, George M., and Green, Jeffery. 1974. Home Mortgage Delinquencies: A Cohort Analysis. *The Journal of Finance* 29(5):1545–1548.

## **Appendix A. Variable Names and Definitions**

### **DEPENDENT VARIABLE**

**Non Performing Loan (NPL) Dummy** If there are two consecutive installments which are missed, this variable is set to 1, else the variable is 0. The variable is switched to 0 from one if six payments are made after delayed payment period

**Real Value of the Loan Principal** The CPI index adjusted value of the mortgage loan principal

### **INDEPENDENT VARIABLES**

**Principal in TL** Defines the original loan amount in TL.

**Installment** Defines the number of installments for the loan amount.

**Year of Loan** Defines year of opening date of the loan.

**Gender** Dummy. Gender: 1 if male and 0 if female.

**Married** Dummy. Marital status: 1 married, 0 else.

**Age** Age of investor at the end of the sample period.

**Banking Dummy non-bank job.** Investor's job at the end of the sample period: 1 if banking job and 0 if non-bank job.

**Accounting Dummy if non-accounting job.** Investor's job at the end of the sample period: 1 if accounting job and 0 if non-accounting job.



Broker Dummy                      Investor's job at the end of the sample period: 1 if broker, and 0 if non-brokerage job.

Insurance Dummy                      Investor's job at the end of the sample period: 1 if insurance related job, and 0 if non-insurance related job.

Business Administration, Economics Dummy Investor's job at the end of the sample period: 1 if business administrator, or economist, and else 0.

Other Finance Profession Dummy Investor's job at the end of the sample period: 1 if any finance related job as profession other than above, and else 0.

General Manager Dummy    Investor's executive level at the end of the sample period: 1 if general manager and else 0.

Member of the Board Dummy Investor's executive level at the end of the sample period: 1 if member of the board and else 0.

General Manager Dummy    Investor's executive level at the end of the sample period: 1 if owner of a large firm and else 0.

Owner Dummy                      Investor's executive level at the end of the sample period: 1 if owner of a large firm and else 0.

Istanbul Dummy                      City where the investor's account is opened: 1 if Istanbul and 0 if not-Istanbul.

Ankara Dummy                      City where the investor's account is opened: 1 if Ankara and 0 if not-Ankara.

Izmir Dummy                      City where the investor's account is opened: 1 if Izmir and 0 if not-Izmir.

Elementary Dummy                      Elementary School Education of investor: 1 if highest level of education at the end of sample period is Elementary School, 0 else.

High School Dummy                      High School Education of investor: 1 if highest level of education at the end of sample period is High School, 0 else.

College Dummy                      College education of investor: 1 if *up to* university degree or two-year further education after High School, 0 else.

Master, PhD Dummy                      Post-graduate education of investor: 1 if *up to* graduate, masters or PhD degree, 0 else.

**Table 1. Summary Statistics**

Panel A. Whole Sample and Defaulted Loans (2002-2011)

	All			Defaulted Loans		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Non Performing Loan (NPL)	0.6%	-	1	1.0%	1	1
Principal in TL	70,889	941	7,070,000	78,503	12,400	419,200
Installment	85	1	240	94	18	240
Gender Male	77.9%	-	1	80.0%	-	1
Marital Status as Married	78.3%	-	1	77.0%	-	1
Age	41	18	84	42	21	67
<i>Banking Profession</i>	0.4%	-	1	0.2%	-	1
<i>Accounting Profession</i>	2.8%	-	1	2.7%	-	1
<i>Broker Profession</i>	0.0%	-	1	0.0%	-	-
<i>Insurance Profession</i>	0.1%	-	1	0.0%	-	-
<i>Business Administration, Economics Profession</i>	0.3%	-	1	0.0%	-	-
<i>Other Finance Profession</i>	0.1%	-	1	0.3%	-	1
All Finance Profession Cumulative	3.8%	-	1	3.2%	-	1
<i>General Manager</i>	0.7%	-	1	1.2%	-	1
<i>Owner of a large Firm</i>	0.1%	-	1	0.0%	-	-
<i>Member of Board</i>	0.0%	-	1	0.0%	-	-
All Executive Cumulative	0.8%	-	1	1.2%	-	1
Istanbul	30.9%	-	1	32.0%	-	1
Ankara	15.3%	-	1	11.1%	-	1
Izmir	5.0%	-	1	4.5%	-	1
Elementary School Degree	18.1%	-	1	17.5%	-	1
High School Degree	33.1%	-	1	42.5%	-	1
Undergraduate Degree	25.5%	-	1	17.5%	-	1
Graduate Degree	8.3%	-	1	3.5%	-	1

## Panel B. Yearly Statistics

	2002			2003			2004			2005		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Non Performing Loan (NPL)	0.0%	-	-	0.0%	-	-	0.0%	-	-	0.6%	-	1
Principal in TL	49,344	2,512	96,175	149,060	20,672	488,400	87,768	23,000	272,400	53,687	1,166	1,100,000
Installment	1	1	120	120	120	120	113	96	120	111	60	240
Gender	100.0%	1	1	75.0%	-	1	85.7%	-	1	72.2%	-	1
Married	100.0%	1	1	91.7%	-	1	85.7%	-	1	84.4%	-	1
Age	51	51	51	47	41	69	40	33	49	44	26	84
<i>Banking Profession</i>	-	-	-	0.0%	-	-	0.0%	-	-	1.7%	-	1
<i>Accounting Profession</i>	-	-	-	0.0%	-	-	0.0%	-	-	3.4%	-	1
<i>Broker Profession</i>	-	-	-	0.0%	-	-	0.0%	-	-	0.0%	-	1
<i>Insurance Profession</i>	-	-	-	0.0%	-	-	0.0%	-	-	0.2%	-	1
<i>Other Finance Profession</i>	-	-	-	0.0%	-	-	0.0%	-	-	0.1%	-	1
<u>All Finance Profession Cumulative</u>	-	-	-	0.0%	-	-	0.0%	-	-	5.6%	-	1
<i>General Manager</i>	-	-	-	8.3%	-	1	0.0%	-	-	1.4%	-	1
<i>Owner of a large Firm</i>	-	-	-	0.0%	-	-	0.0%	-	-	0.2%	-	1
<i>Member of Board</i>	-	-	-	0.0%	-	-	0.0%	-	-	0.0%	-	-
<u>All Executive Cumulative</u>	-	-	-	8.3%	-	1	0.0%	-	-	1.6%	-	1
Istanbul	100.0%	1	1	46.2%	-	1	42.9%	-	1	25.8%	-	1
Ankara	0.0%	-	-	23.1%	-	1	14.3%	-	1	15.3%	-	1
Izmir	0.0%	-	-	23.1%	-	1	14.3%	-	1	6.4%	-	1
Elementary School Degree	0.0%	-	-	8.3%	-	1	28.6%	-	1	21.5%	-	1
High School Degree	0.0%	-	-	16.7%	-	1	14.3%	-	1	34.0%	-	1
Undergraduate Degree	0.0%	-	-	41.7%	-	1	14.3%	-	1	33.8%	-	1
Graduate Degree	100.0%	1	1	83.3%	-	1	14.3%	-	1	3.9%	-	1

	2006			2007			2008			2009		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Non Performing Loan (NPL)	0.5%	-	1	1.1%	-	1	1.8%	-	1	0.7%	-	1
Principal in TL	64,081	1,238	2,170,000	78,609	2,038	2,355,000	73,371	1,245	3,750,000	68,064	988	7,070,000
Installment	105	53	240	83	40	240	82	24	240	70	15	180
Gender	73.3%	-	1	78.1%	-	1	79.4%	-	1	77.8%	-	1
Married	83.6%	-	1	76.8%	-	1	76.6%	-	1	77.5%	-	1
Age	44	23	79	42	22	73	41	21	79	40	20	78
<i>Banking Profession</i>	1.3%	-	1	1.0%	-	1	0.7%	-	1	0.6%	-	1
<i>Accounting Profession</i>	3.6%	-	1	2.8%	-	1	2.7%	-	1	2.9%	-	1
<i>Broker Profession</i>	0.0%	-	1	0.0%	-	1	0.0%	-	-	0.0%	-	1
<i>Insurance Profession</i>	0.2%	-	1	0.1%	-	1	0.2%	-	1	0.2%	-	1
<i>Other Finance Profession</i>	0.1%	-	1	0.1%	-	1	0.2%	-	1	0.1%	-	1
<u>All Finance Profession Cumulative</u>	5.3%	-	1	4.1%	-	1	3.8%	-	1	3.8%	-	1
<i>General Manager</i>	1.2%	-	1	1.0%	-	1	0.8%	-	1	0.9%	-	1
<i>Owner of a large Firm</i>	0.2%	-	1	0.3%	-	1	0.4%	-	1	0.1%	-	1
<i>Member of Board</i>	0.0%	-	1	0.0%	-	1	0.0%	-	-	0.0%	-	-
<u>All Executive Cumulative</u>	1.5%	-	1	1.4%	-	1	1.3%	-	1	1.1%	-	1
Istanbul	27.3%	-	1	41.4%	-	1	38.3%	-	1	32.2%	-	1
Ankara	17.0%	-	1	11.4%	-	1	9.9%	-	1	12.6%	-	1
Izmir	5.9%	-	1	4.8%	-	1	3.9%	-	1	5.4%	-	1
Elementary School Degree	19.8%	-	1	17.0%	-	1	16.8%	-	1	14.9%	-	1
High School Degree	32.1%	-	1	24.9%	-	1	28.4%	-	1	35.9%	-	1
Undergraduate Degree	32.0%	-	1	24.8%	-	1	19.9%	-	1	27.6%	-	1
Graduate Degree	4.2%	-	1	4.3%	-	1	3.7%	-	1	10.6%	-	1

	2010			2011		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Non Performing Loan (NPL)	0.4%	-	1	0.1%	-	1
Principal in TL	72,803	941	3,022,400	70,946	3,479	3,890,681
Installment	85	6	240	93	3	206
Gender	78.2%	-	1	78.9%	-	1
Married	78.8%	-	1	76.7%	-	1
Age	39	20	80	38	18	70
<i>Banking Profession</i>	0.2%	-	1	0.1%	-	1
<i>Accounting Profession</i>	2.7%	-	1	2.8%	-	1
<i>Broker Profession</i>	0.0%	-	-	0.0%	-	1
<i>Insurance Profession</i>	0.1%	-	1	0.1%	-	1
<i>Other Finance Profession</i>	0.1%	-	1	0.0%	-	1
<u>All Finance Profession Cumulative</u>	3.1%	-	1	2.9%	-	1
<i>General Manager</i>	0.6%	-	1	0.4%	-	1
<i>Owner of a large Firm</i>	0.0%	-	1	0.0%	-	1
<i>Member of Board</i>	0.0%	-	-	0.0%	-	-
<u>All Executive Cumulative</u>	0.7%	-	1	0.4%	-	1
Istanbul	30.2%	-	1	26.8%	-	1
Ankara	16.1%	-	1	19.4%	-	1
Izmir	4.9%	-	1	4.8%	-	1
Elementary School Degree	18.4%	-	1	20.6%	-	1
High School Degree	34.2%	-	1	31.8%	-	1
Undergraduate Degree	25.5%	-	1	22.6%	-	1
Graduate Degree	9.6%	-	1	7.8%	-	1

**Table 2. Summary Statistics of Loan and Year**

Year	Mean of Loans in TL	Mean of Loans in Real Values in TL	Mean of Defaulted Loans in TL	Mean Defaulted Loans in Real TL	Defaulted Loans Ratio (Number)	End-of-Year Mortgage Reference Interest Rate	End-of-Year Mortgage Inflation Rate	End-of-Year Unemployment Rate
2002	49,343	49,343	-	-	-	-	29.8%	-
2003	149,060	125,943	-	-	-	-	18.4%	-
2004	87,767	67,834	-	-	-	-	9.3%	-
2005	53,686	37,541	69,733	48,761	0.6%	-	10.5%	11.5%
2006	64,080	40,867	67,008	42,734	0.5%	-	9.7%	10.9%
2007	78,608	46,249	84,214	59,548	<b>1.1%</b>	7.1%	8.4%	10.9%
2008	73,370	39,220	76,060	40,658	<b>1.8%</b>	11.1%	10.1%	14.0%
2009	68,064	34,155	76,248	38,262	0.7%	5.3%	6.5%	13.5%
2010	72,803	34,335	81,882	38,617	0.3%	9.2%	6.4%	11.4%
2011	70,345	30,294	84,532	36,096	0.1%	6.2%	10.5%	9.8%
All	70,889	34,630	78,503	40,425	0.5%			

Year	Number of Loans Generated	Total Loans in TL	Total Loans in Real TL	Defaulted Loans (Loan Start Year)	Total Defaulted Loans in TL	Total Defaulted Loans in Real TL	Defaulted Loans Ratio (Value)
2002	2	98,687	98,687	-	-	-	-
2003	13	1,937,780	1,637,254	-	-	-	-
2004	7	614,373	474,838	-	-	-	-
2005	2,657	142,645,981	99,746,625	15	1,046,000	731,425	0.7%
2006	4,728	302,972,942	193,218,659	23	1,541,198	982,887	0.5%
2007	4,676	367,574,120	216,263,335	53	4,463,387	2,626,047	1.2%
2008	7,849	575,887,101	307,844,018	138	10,496,362	5,610,895	1.8%
2009	19,879	1,353,051,536	678,973,531	131	9,988,545	5,012,342	0.7%
2010	39,908	2,905,428,805	1,370,260,449	129	14,657,043	6,912,565	0.5%
2011	18,052	1,280,710,731	546,871,502	20	1,690,659	721,921	0.1%
All	97,771	6,930,922,056	3,415,388,898	509	43,883,194	22,598,082	0.6%

**Table 3.** Binary Logit for the Whole Sample

Dependent Variable Non-Performing Loans Dummy				
	Coefficient	z-statistic		p-value
Intercept	392.7765	6.7446	***	-
Principal in TL	0.5228	6.5360	***	-
Installment	0.0071	5.2298	***	-
Year of Loan	-0.2011	-6.9712	***	-
Gender	0.2267	1.7911	*	0.0733
Married	-0.0857	-0.6851		0.4933
Age	-0.0478	-0.1951		0.8453
Executive Dummy	-0.2045	-0.4434		0.6575
Finance Dummy	-0.1817	-0.6386		0.5231
Istanbul	-0.0285	-0.2466		0.8052
Ankara	-0.2701	-1.7144	*	0.0864
Izmir	-0.5917	-2.0504	**	0.0403
McFadden R <sup>2</sup>	2.98%			
LR Statistic	152.9100			
Prob (LR) Statistic	0.0000			
Obs.	84,678			

Principal is in logarithm, real numbers based on 2002 Consumer Price Index and converted to TL.

Installment is number of months for the loan paid.

Year of loan defines year of opening of the loan.

Age is in logarithm. Gender is 1 is male else 0. Married is 1 if married else 0.

Executive dummy is equal to 1, if the person is an executive or owner of a large firm and is 0 otherwise.

Finance dummy is equal to 1, if the person works in any finance related job other than the above described finance professions, and is 0 otherwise. Istanbul dummy is 1 if loan is generated from Istanbul else 0.

Ankara dummy is 1 if loan is generated from Istanbul else 0.

Izmir dummy is 1 if loan is generated from Istanbul else 0.

**Table 4.** Stepwise Regression Model for the Defaulted Loans

Dependent Variable Real Value of Loan Principal in TL				
	Coefficient	F-value	p-value	
Intercept	1938.2718	202.6700	***	-
Installment	-0.4354	192.3100	***	-
Remaining Loan Real	0.7789	1330.8500	***	-
Year	-254.2795	201.6600	***	-
Other Finance	0.3519	2.1800		0.1409
Istanbul	0.0433	3.0400	*	0.0821
High School Degree	0.0408	2.4400		0.1189
Undergraduate Degree	0.1616	22.3600	***	-
Adjusted R <sup>2</sup>	79.62%			
F statistic	220.98			
p-value (Fstat)	0.0001			
Obs.	403			

Principal is in logarithm, real numbers based on 2002 Consumer Price Index and converted to TL.

Remaining loan real is in logarithm, real numbers based on 2002 Consumer Price Index and converted to TL.

Installment and year are in logarithm number of months for the loan paid.

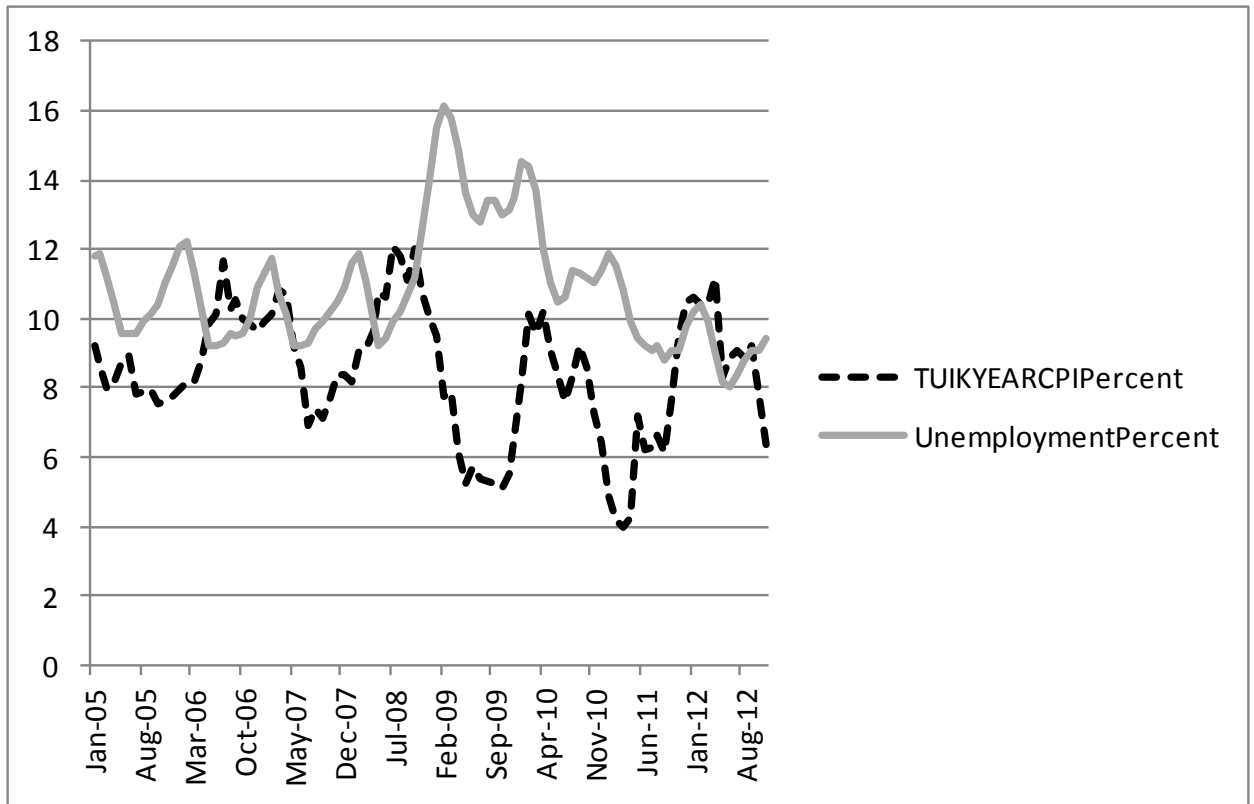
Age is in logarithm.

Dummy equal to 1 if other finance job else 0.

Istanbul dummy is 1 if loan is generated from Istanbul else 0.

High school and college dummy is 1 if high school degree or undergraduate education else 0.

**Graph I.** Consumer Price Inflation and Unemployment Rate (End-of-Year)\*



\*The data of TUIK.

**Graph II.** Total Mortgage Loans, Consumer Price Inflation and Unemployment Rate (End-of-Year)\*

