RESEARCH ARTICLE

Determining the Credit Rating and the Maximum Amount of Bank Loan for the Household Debtor

Bistriceanu Gabriel*

National Bank of Romania-Bucharest, Monetary Policy Department, 25 Lipscani Street, Sector 3, zip code: 040421.

*Corresponding Author: E-mail: **Gabriel.Bistriceanu@bnro.ro or gabriel.bistriceanu@gmail.com***

Abstract

First, the present paper develops a methodology for establishing the credit rating for a household debtor. The methodology consists in establishing the quantitative and qualitative indicators, setting the scores for each indicator and determining the credit rating category for the household debtor that apply for a loan from a bank. Second, other issues addressed in the paper are establishing the source of the loan repayment for the household debtor and determining the maximum amount of bank loan for the household debtor based on the information obtained from the analysis of credit rating. Finally, using the methodologies obtained in the paper, it is presented a comparative case study for three household debtors.

Keywords: *Credit rating, Bank evaluation of the household debtor, Annuity, Maximum amount of bank loan, Degree of indebtedness.*

Introduction

In retail banking activity, the credit rating is a numerical qualification expressing the opinion of the bank regarding the household debtor's ability to meet in full and on time its obligations regarding the loans reimbursement payments made to the bank. Credit rating is determined by the bank based on the analysis of two categories of criteria for the household debtor:

- Quantitative criteria.

- Qualitative criteria. Each of quantitative and qualitative criteria has a weight at the calculation of the credit rating of the borrower, so that the credit rating is a weighted arithmetic average of the scores criteria, weighted by their respective weights.

As opposed to the quantitative criteria for credit analysis, the qualitative analysis is based on less quantifiable in numbers criteria and it completes the quantitative analysis results.

The credit rating is important both for the bank and the household debtor because it allows:

- Determining the decision to grant (or not) of a loan by the bank. To obtain the credit, it is necessary a credit rating within the limits accepted by the bank.

- To establish the credit risk margin used for indexing the interbank money market interest rate in order to establish the interest rate on the loan obtained by the borrower from the bank. The more risky is the borrower, the higher is the credit risk margin and vice versa.

- To determine the maximum degree of indebtedness of the borrower. The more risky is the borrower, the lower is the degree of indebtedness of the debtor that the bank should establish.

- The bank better management of credit risk by monitoring the latter over the repayment period of loans by the borrowers.

- The use by banks of credit rating along with other two elements, represented by the number of days of delay in repayment of debt and the initiate of foreclosure proceedings / bankruptcy of the debtor, for the classification of bank loans in the five categories of loans: standard, in observation, substandard, doubtful or loss. This latter classification is done by banks in order to cover the loans depreciation by provisioning.

According to U.S. Securities and Exchange Commission [1], the credit rating generally reflect a relative ranking of credit risk. For example, a debtor with a high credit rating is assessed by the credit rating agency to have a lower likelihood of default than a debtor with a lower credit rating. Credit rating scales, symbols, and definitions may vary among credit rating agencies. A typical credit rating scale has a top rating of 'AAA' and may have a lowest rating of 'D' (indicating default).

Altman and Saunders [2] mentioned that credit risk measurement has evolved dramatically over the last 20 years and more academics and practitioners alike have developed new and more sophisticated credit-scoring/early-warning systems, moved away from only analyzing the credit risk of individual loans and securities towards developing measures of credit concentration risk, where the assessment of credit risk plays a central role and developed new models to price credit risk.

Hand and Henley [3] surveyed the statistical techniques used in the process of building a credit scoring model.

Allen et. al. [1] surveyed a lot of BIS proposals for the credit risk measurement of retail credits in capital regulations. They surveyed proprietary credit scoring models (such as Fair Isaac), as well as options-theoretic structural models (such as KMV and Moody's RiskCalc), and reduced-form models (such as Credit Risk Plus). These models allow lenders and regulators to develop techniques that rely on portfolio aggregation to measure retail credit risk exposure.

Avery et al. [5] looked at whether the situational circumstances matter for consumer credit scoring. Evidence from a U.S. national sample of credit reporting agency records suggests that failure to consider measures of local economic circumstances and individual trigger events when developing credit history scores can diminish the potential effectiveness of such models. There are practical difficulties, however, associated with developing scoring models that incorporate situational data, arising largely because of inherent limitations of the credit reporting agency databases used to build scoring models.

Dinh and Kleimeier [6] proposed a credit scoring model for Vietnamese retail loans. They showed how to identify those borrower characteristics that should be part of a credit scoring model,

illustrated how such a model can be calibrated to achieve the strategic objectives of the bank and assessed the use of credit scoring models in the context of transactional versus relationship lending.

Kočenda and Vojtek [7] developed a specification of the credit scoring model with high discriminatory power to analyze data on loans at the retail banking market. They used a parametric and non- parametric approaches to produce three models using logistic regression (parametric) and one model using Classification and Regression Trees (CART, nonparametric).

The models used are able to detect the most important characteristics of household default behavior: the amount of resources the client has, the level of education, marital status, the purpose of the loan, and the number of years the client has had an account with the bank. The sociodemographic variables are important in the process of granting credit and therefore such variables should not be excluded from credit scoring model specification.

Establishing the Credit Rating of the Household Debtor

In order to determine a methodology for establishing the credit rating for the household debtor, we propose to be used five quantitative and qualitative indicators (or criteria), having a main significance in assessing credit worthiness of the household borrower:

- Loan applicant total revenue (and eventually co-debtors).

- Seniority at the current job.

- Own contribution (advance, calculated as a percentage of the purchased good price) brought by the debtor, in addition to the bank loan, for buying the good.

- Historical relationship of the debtor with the bank; (v) collateral characteristics.

The first three criteria above are considered to be quantitative as are found expressed in numbers. The last two criteria are considered to be qualitative as are found to be less quantifiable in numbers.For each of the above five criteria we set the following scores: 1 point, 2 points, 3 points, 4 points or 5 points (the best are the 5 points score). We set the scores for the five quantitative and qualitative indicators as presented in Table 1.

Table 1: The correspondence between the quantitative, qualitative indicators and the scores for the household debtor

Scores (in points)	Quantitative and Qualitative Indicators				
	Loan applicant (including co-debtor) total revenue per month (R)	Seniority of the loan applicant at the current job (S)	Own contribution (advance) brought by the debtor, in addition to the bank loan (C)	Historical relationship of the debtor with the bank	Collateral characteristics
1	R<1000 euro	S<1 year	C<10%	no previous reference with the bank	real guarantees with very low liquidity
2	1000 <=R R<1500 euro	1<=S<2 years	10%<=C<15%	current account	real guarantees with low liquidity
3	1500<=R R<2000 euro	2<=S<3 years	15%<=C<20%	current account and debit cards	real guarantees with acceptable liquidity
4	2000<=R R<2500 euro	3<=S<4 years	20%<=C<25%	current account and loans	real guarantees with good liquidity
5	R>=2500 euro	S>=4 years	C>=25%	multiple package of banking products and services, including time deposits and loans	real guarantees with very good liquidity

As it can be seen in Table 1 above, the bank firstly prefers to have as borrowers the households with high revenue. In the case that the bank has historical data series on income of household borrowers, the bank may use a QUARTILE analysis to determine the extremities of the interval indicator R. The situation for indicator R from Table 1 we consider that it can be representative for euro area.

On the seniority at current job, we can say that a greater number of working years for the same employer brings a plus to the rating (in the table above, we can say that seniority higher than 4 years means high stability of the borrower on the current job); this criterion can be used by the bank to show the stability of debtor's income, as a source of future repayment of the loan obtained from the bank.

It is preferable for the bank that the debtor come with an advance (own contribution) to the good purchased using the bank loan. In Table 1, an own contribution higher than 25% of the purchased good price, for instance, give the highest score (5 points) for this criterion at the debtor evaluation. Sometimes, the banking regulatory and supervisory authority may impose by regulation that the banks require to the

borrowers a certain level of advance (say 15% - 20%), especially for higher value loans as mortgage loans. The advance reduces the credit risk for the bank.

Certainly, the banks primarily prefer to grant credit to household with which the bank have developed banking activities in the past. The natural persons who have received other loans from the bank and reimbursed them properly and those that have opened various accounts (current account, debit cards, time deposits) at this bank that grants the current loan will get additional points to the credit rating because the bank believes that they have a lower credit risk than the individuals who had not banking relationships with the bank previously.

The real guarantees with very good liquidity (like government bonds, collateral deposits) are preferred primarily by the lending banks, they being interested in easily capitalize guarantees if the household debtors does not reimburse their loans adequately.

Further, we established the credit rating of the household debtor as a weighted arithmetic average, with equal weights, of the scores obtained for the five categories of indicators (three

quantitative indicators and two qualitative indicators), as follows:

$$CR = \sum_{i=1}^{5} p_i * w_i \qquad (1)$$

where: CR is the credit rating of the household debtor;

p_i is the score for the i criterion; $p_i \subset \{1,2,3,4,5\}$;

i is one of the following quantitative and qualitative indicators: loan applicant (including co-debtor) total revenue, seniority of the loan applicant at the current job, own contribution (advance) brought by the debtor, in addition to the bank loan, historical relationship of the debtor with the bank, collateral characteristics. $i = \overline{1...5}$;

$\sum_{i=1}^{5} w_i = 100\%$, where: $w_1 = w_2 = ... = w_5 = 20\%$.

$$CR = QTCR + QLCR \qquad (2)$$

$$QTCR = \sum_{i=1}^{3} p_i * w_i ,$$

$$QLCR = \sum_{i=4}^{5} p_i * w_i ,$$

where: $QTCR$ is the credit rating of the quantitative criteria and $QLCR$ is the credit rating of the qualitative criteria.

We set the credit rating categories, as follows (Table 2):

Table 2: The credit rating category of the household debtor

Credit Ratings (CR) in points	4<CR<=5	3<R<=4	2<R<=3	1.5<CR<=2	1<=CR<=1.5
Credit rating category	A	B	C	D	E

The five categories of credit ratings of household debtor expresses the following aspects:

- Category A: includes all bank' customers whose quantitative and qualitative indicators are very good and allow the payment of credit rates and interest at maturity. Also, it is envisaged the prospect of maintaining a high level of financial trustworthiness of the household debtor.

- Category B: the quantitative and qualitative indicators are good or very good, but can not be maintained at this level on a longer perspective.

- Category C: the quantitative and qualitative indicators are satisfactory, but a clear trend of worsening.

- Category D: the quantitative and qualitative indicators are low.

- Category E: the quantitative and qualitative indicators are very low and there is a clear perspective that cannot be paid any credit or interest rates.

Generally, the banks prefer to lend to creditworthy customers with high rating categories, namely in A, B, C, because in these cases the credit risk is much lower than in the other two cases D and E.

Determining the Source of Loan Repayment for the Household Debtor

Since the main source of income for individuals is salary, the latter is the main source of loan repayment for the household debtor. Besides salary, other revenue considered eligible for reimbursement the bank loans by the household debtor are:

- Retirement income.
- Rental income.
- Revenues from the sale of copyrights.
- Income received by navigators.
- Income from sales commissions.
- Dividend income.
- Interest income.
- Income from liberal professions (doctors, lawyers, notaries, architects).
- Securities sales revenues.

Other revenues sources accepted by banks and backed by legal acts.

Because some of these revenues above are not necessarily permanent (or repeated), it is possible for banks to adjust them by a decreasing adjustment factor. For example, rents, sales commissions, dividends, income from abroad are taken into account in determining disposable

income by multiplying the decreasing adjustment (between 30% and 80%) with the amount of such income.

Because the main personal income is income from salary, the repayment of loans is made usually monthly by the household debtors. The other incomes that have not monthly frequency values are converted to monthly values by dividing the incomes values to the number of months of the period in which they are received by the household.

The maximum amount of loan that an individual can get from the bank is directly proportional to the debtor's monthly disposable revenue (and co-debtor if applicable). Thus, for the debtor's monthly disposable revenue (plus co-debtors as appropriate), there is the following relationship:

Monthly disposable revenue = Total monthly revenues amount of the borrower and co-debtors (if applicable) - Minimum living expenses per month - Other monthly installments payable on other loans and / or leases (3)

The minimum living expenses per month (or subsistence costs) is established by the bank on a case by case basis for each individual, depending on the number of family members. Subsistence costs can be calculated based on a minimum consumption basket of the family and/or taking into account the geographical area of residence of the debtor. In general, each bank sets a fixed cost of subsistence cost per family member.

The banks can establish the maximum degrees of indebtedness for household borrowers based on the debtor's credit rating. When the credit rating is good, the maximum degree of indebtedness is high and vice versa. For household debtor, the maximum degree of indebtedness is calculated as a ratio between the total monthly payment rate of the borrower and his monthly disposable revenue and represents what percentage of monthly disposable revenue the debtor can pay each month to pay the loan rate:

$$MXDI = \frac{TMPR}{MDV} * 100 \tag{4}$$

where: $MXDI$ is the maximum degree of indebtedness of the household borrower;

$TMPR$ is the total maximum monthly payment rate that is repaid by the borrower each month;
MDV is the total monthly disposable revenue.

The overall maximum monthly payment rate for the loan is determined according to the above relation, by multiplying the maximum degree of indebtedness with the monthly disposable revenue. $MXDI$ is less than 100% due to the interest rate risk and exchange rate risk of the household borrower, forecasting errors in disposable income and the emergence of contingency for individual debtor. Examples of maximum degrees of indebtedness: 40%, 50%, 60%.

For each month j, in the case of equal annuities (see below) we have the following relationship:

$$TMPR = R_{\max} + F \tag{5}$$
where:
$TMPR$ is total monthly payment rate for month j;
$R_{\max}$ is the maximum reimbursed rate for month j;
F is a monthly fees that that in some cases the debtor has to pay for the administration of the loan by the bank.
If $F = 0$, we have:

$$TMPR = R_{\max} \tag{6}$$

Determining the Maximum Amount of Bank Loan for the Household Debtor. Hypothetical Case Study

In the case of the household borrowers, the most common way of reimburse the bank loans is the repayment in equal monthly rates (equal installments or equal annuities).

Let us consider the following notations and relationships:

L is the nominal value of bank loan;
IR is the interest rate (in percent per year) from the bank credit agreement;
ir is the interest rate on the reimbursement period. Usually, in the case of the household debtors, the reimbursement is done monthly (see above). Then, $ir = \dfrac{IR}{12}$;
L is the nominal value of bank loan;

T is the original maturity of the loan (maturity fixed at the beginning of credit, by the credit agreement). T is a multiple n of the same reimbursement periods; n is the total number of reimbursement periods (months in our case) from

the initial T maturity of the bank loan; j is the order number of the loan reimbursement period. $j = \overline{1...n}$; P_j is the one principal rate from the loan with the order number j. We have the following relationship:

$$\sum_{j=1}^{n} P_j = L \tag{7}$$

R_j is the reimbursed rate for month j;

I_j is the interest corresponding to a order number j;

$$I_j = L_j * ir \tag{8}$$

where L_j is the remaining balance to be reimbursed from the loan after there were reimbursed $j-1$ parts of principal P_j;

For the reimbursed rate we have the following relationship:

$$R_j = P_j + D_j \tag{9}$$

In the following we deduce a relationship for the reimbursed rates, all equal to R. Hence, it is known that

$$R_1 = R_2 = ... = R_n = R \tag{10}$$

For R_1 and R_2 we have, using (9):

$$R_1 = P_1 + I_1 = P_1 + ir * L$$
$$R_2 = P_2 + I_2 = P_2 + ir * (L - P_1)$$

But, according to (10) $R_1 = R_2$ and it results:

$$P_1 + ir * L = P_2 + ir * L - ir * P_1$$

We obtain:

$$P_2 = P_1 * (1 + ir) \tag{11}$$

At the same time:

$$R_3 = P_3 + I_3 = P_3 + ir * (L - P_1 - P_2)$$
$$R_1 = R_3 \Rightarrow P_1 + ir * L = P_3 + ir * L - ir * P_1 - ir * P_2$$
$$\Rightarrow P_1 = P_3 - ir * P_1 - ir * P_1 * (1 + ir)$$

We obtain:

$$P_3 = P_1 * (1 + ir)^2 \tag{12}$$

It results, by induction, that:

$$P_n = P_1 * (1 + ir)^{n-1} \tag{13}$$

Using (7) and (13), we have:

$$L = \sum_{j=1}^{n} P_j = P_1 * (1 + ir)^0 + P_1 * (1 + ir)^1 + P_1 * (1 + ir)^2 + ... + P_1 * (1 + ir)^{n-1}$$

We calculate the progression above and we have that:

$$L = P_1 * \frac{(1 + ir)^n - 1}{ir} \tag{14}$$

$$\Rightarrow$$

$$P_1 = \frac{ir * L}{(1 + ir)^n - 1} \tag{15}$$

And we have that:

$$R_1 = P_1 + I_1 = \frac{ir * L}{(1 + ir)^n - 1} + ir * L \tag{16}$$

But, at the reimbursement in equal installments we have that all rates are equal with the first rate R_1 ($R_1 = R$). It results that:

$$R = \frac{ir * L}{(1 + ir)^n - 1} + ir * L \tag{17}$$

Let us note with L_{max} the maximum amount of bank loan that a household debtor can obtain. Also, let us note with R_{max} the maximum reimbursed rate. Replacing L with L_{max} and R with R_{max} in the relationship (17), it results that:

$$L_{max} = \frac{R_{max}}{\frac{ir}{(1 + ir)^n - 1} + ir} \tag{18}$$

Hypothetical example. As a case study, let us consider the following:

Let us consider a bank that uses the credit rating category of a household debtor to establish the maximum degree of indebtedness and the credit risk margin of the household debtor as we mention in Table 3.

Table 3: Using the credit rating category to establish the maximum degree of indebtedness and the credit risk margin of the household debtor

Credit rating category	Maximum degree of indebtedness of the household debtor, in %	Credit risk margin of the household debtor, in percentage points (pp)
A	60	2
B	50	3
C	40	4
D	30	5
E	20	6

The credit rating category is established by this bank using the issues mentioned in the section 2 above of the paper. The credit risk margin is also called the interest margin and is used by the bank to index the interbank money market interest

rate in order to obtain the interest rate applied for the loan that is granted to a household debtor.

Further, let us consider three households that apply for obtains loans from the bank above. The detailed information for the three households is presented in Table 4 below.

Table 4: Detailed information on three household debtors. Hypothetical example

Household debtor 1	Household debtor 2	Household debtor 2
Total monthly revenue = 2500 euro; Seniority of the loan applicant at the current job = 4 years; Own contribution (advance) brought by the debtor, in addition to the bank loan = 25%; Historical relationship of the debtor with the bank = current account and debit cards; Collateral characteristics = real guarantees with acceptable liquidity; The household debtor 1 = a family of 2 persons.	Total monthly revenue = 2500 euro; Seniority of the loan applicant at the current job = 3 years; Own contribution (advance) brought by the debtor, in addition to the bank loan = 20% Historical relationship of the debtor with the bank = no previous reference with the bank; Collateral characteristics = real guarantees with low liquidity; Other monthly installment payable on other loans, other than the current loan that is accessed to this bank = 500 euro per month; The household debtor 2 = 1 person.	Total monthly revenue = 1500 euro; Seniority of the loan applicant at the current job = 2 years; Own contribution (advance) brought by the debtor, in addition to the bank loan = 15% Historical relationship of the debtor with the bank = no previous reference with the bank; Collateral characteristics = real guarantees with low liquidity; The household debtor 3 = 1 person.

The bank establishes: (i) the minimum living expenses at a value of 300 euros per person, per month; (ii) the interest rate for the household loan =EURIBOR3m + Credit risk margin of the household debtor. At present, when applying for loan applications of households, the EURIBOR at 3 months is 2 percent.

Using all the relationships obtained in this paper and the information from our hypothetical case study, it results the following results presented in Table 5. We calculated the maximum amount of bank loan for an original maturity of 1 year (i.e. 12 months), 5 years (i.e. 60 months) and 10 years (i.e. 120 months). We considered the loan reimbursement in monthly equal rates (monthly equal annuities).

Table 5: Credit ratings, maximum degrees of indebtedness, credit risk margin, interest rate, total monthly disposable revenue, maximum monthly reimbursed rate and the maximum amount of bank loan that a household debtor can obtain for the three household debtors from the hypothetical example

	Household debtor 1	Household debtor 2	Household debtor 3
Credit rating	4.2 points	3.2 points	2.4 points
Credit rating category	A	B	C
Maximum degree of indebtedness	60%	50%	40%
Credit risk margin	2 pp	3 pp	4 pp
Interest rate for loan	4%	5%	6%
Total monthly disposable revenue	1900 euro	1700 euro	1200 euro
Maximum monthly reimbursed rate	1140 euro	850 euro	480 euro
Maximum amount of the bank loan for 1 year maturity	13388 euro	9929 euro	5577 euro
Maximum amount of the bank loan for 5 years maturity	61901 euro	45042 euro	24828 euro
Maximum amount of the bank loan for 10 years maturity	112598 euro	80139 euro	43235 euro

In Table 5 above, we can see the following: The household debtor 1 has the highest credit rating and, consequently, the highest degree of indebtedness and the lowest interest rate.

- The household debtors 2 and 3 have lower credit ratings, lower degree of indebtedness, higher interest rates than the debtor 1.

- Although the household debtor 1 and 2 have the same total monthly revenue of 2500 euro, the total monthly disposable revenue (as a source of loan reimbursement) is higher in the case of debtor 1 as compared with the debtor 2 because the debtor 1 has a higher credit rating than the debtor 2 and the debtor 2 has to pay another monthly installment of 500 euro per month that is higher than the minimum living expenses of 300 euro.

- The maximum monthly reimbursed rate has a directly proportional impact on the maximum amount of loan that can be obtained by the household from the bank.

- The maximum amount of loan increases if it is extended the original maturity of the loan.

Conclusions

The findings of this paper are multiple. First, it is developed a methodology for establishing the credit rating category for the household debtor that apply for a loan from a bank. In order to determine the credit rating of the household debtor we proposed to use five quantitative and qualitative indicators: loan applicant total revenue (and eventually co-debtors); seniority at the current job of the applicant; own contribution (advance, calculated as a percentage of the purchased good price) brought by the debtor, in addition to the bank loan, for buying the good; historical relationship of the debtor with the bank; collateral characteristics. The scores for each indicator are from 1 to 5 and the credit rating category was set from A to E. The credit rating methodology obtained in this paper can be used by banks, as internal model, to evaluate the household debtors that apply for a loan at a bank. Second, it is presented a way to determine the total maximum monthly payment rate that is repaid by the household borrower each month.

The maximum degree of indebtedness for household borrowers (established based on the credit rating) and the monthly disposable revenue of the household debtor have a direct influence on the monthly reimbursed rates that are paid each month for the loan. Third, it is obtained a relationship for determining the maximum amount of the bank loan. The maximum reimbursed rate and the original maturity of the loan have positive impact (directly proportional) on the maximum amount of the bank loan, while the interest rate has an inversely proportional influence. Finally, using the methodologies obtained in the paper, it is presented a comparative case study for three household debtors.

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