Effect of Credit Card Holders' Age on the Credit Limit

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Abstract. Credit Limit of the credit cards is one of the affecting factors influencing people's credit scores, playing a great role in determining their ability of paying debts and could be involved in banks evaluation in mortgage. In order to help people better assess their credit scores quantitatively and be aware of the influencing factors that determine their specific credit limits, this paper analyzed 10127 bank customers' data. Based on the estimation, the evaluation is presented according to the information given to obtain the formula used to evaluate people's Credit Limit and its relationship with some influencing factors, e.g., age, gender, education and marital status, and education level. According to the analysis from STATA, it is shown that per unit age increase would increase the credit limit by 1.76 percentage. In addition, impacts of other variables (e.g., gender, education level, marital status, income level, card type, card utilization ratio) are also found. The model presented could be used to help evaluating a persons' Credit Limit according to the data provided. Overall, these results shed light on guiding further exploration of credit limit designs.

Keywords: Credit Limit, Credit Score, Bank Account, Age & Gender.

1. Introduction

The credit limit of a credit card refers to the maximum amount of money that a financial institute(bank) would lend to the client each month. The client needs to pay back the money at the end of the cycle. It is also important for people to keep in mind their credit limits to avoid the risk of causing credit card payments to fail or being charged for excessive fees [1]. Banks usually set the credit limit according to the information provided by the applicants. Those would include personal income, loan repayment history, age, education level, marital status, etc. [2]. The current economic situation and the business circumstance of the bank could also influence the credit limit given [3]. The credit limit is one of the affecting factors influencing people's credit scores. The scores are important when the score holders are willing to purchase their houses or cars [4]. They can affect the percentage of the mortgage paid on the houses or cars and have to do with the interest rate they have to pay on the loan for each term [5]. It can also influence their future credit amount. By comparing the credit limit of a certain customer and the average credit limit of the US, the general financial situation of that individual could be contrasted in certain respective [6]. Hence, it is important to study how to affect this score, as it impacts people's lives on various ends.

According to Leah Zitter's article [7], in the real world, large banks will use calculation software to determine the debt repayment ability of customers applying for credit cards through mathematical formulas, to provide them with the corresponding credit limit. Their calculations include information about previous debt payments. This research mainly analyzes people who already have credit cards, and the author focuses on objective factors (cardholders' age, gender, etc.).

The purpose of this research paper is to investigate the impact of the age of the credit card holder on the credit limit. Other factors that can influence the limit, including the cardholder's educational background, marital status, gender [8], income level, and the type of credit card held, were also analyzed and studied. Those factors were chosen based on Ref. [9] analyzing potential influencing factors of the credit limit and the available database. The rest part of the paper is organized as follows. Sec. 2 will be introducing the data and method used and found during the analysis of the topic, the regression model is also listed. Sec. 3 will be the result discussion part, explaining each variable's influence on the credit limit and providing possible explanations of those effects. Sec.4 will be explaining the limitations of this article's analysis and evaluation while discussing the prospects of the credit card industry. Sec.5 is the conclusion and summary of the whole article.

2. Data & Method

2.1. Data

The data used came from Kaggle.com, and the whole data set contained the information of 10,127 bank customers, including 23 variables containing those customers' personal information. Eight of these variables were chosen to make up the initial data set and generated new variables based on the answers provided. All these data have complete information, so it's not necessary to remove some of them. Table 1 was constructed by STATA accordingly.

Table 1. General Statistical Data about Credit Limit and Variables

Variable	Mean	Std.	Min	Max
credit_limit	8631.95	9088.78	1438.3	34516
logLimit	8.60	0.93	7.27	10.45
customer_age	46.33	8.02	26	73
agesq	2210.36	745.37	676	5329
avg_utilization_ratio	0.27	0.28	0	0.999
educ_dum	4.10	1.83	1	7
marital_dum	2.46	0.74	1	4
gender_dum	0.47	0.50	0	1
income_dum	3.86	1.50	1	6
card_dum	1.18	0.69	1	4

The first two variables are the credit limit and the log of the limit. The later one was generated by log calculation of the first one. By comparing the left and right panels of Fig. 1, it is found that the bar chart of the left is highly skewed to the right, but the trend of a normal distribution is shown in the right. Therefore, it is reasonable to use logLimit data for subsequent credit limit analysis since it has less extreme values.

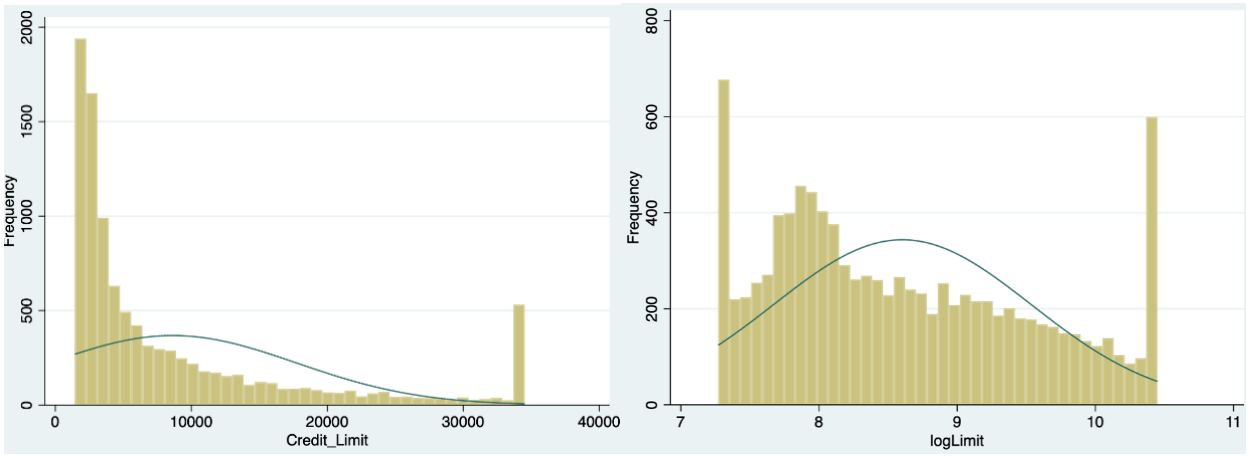


Figure 1. Histogram of the Credit Limit of Bank Holders for regular (left panel) and log scale (right panel)

The third and fourth variables are the consumers' age and the square of their age. For better visualization, the scatter diagram of the credit limit as a function of age is illustrated in Fig. 2. By including these two variables, the influence of the age variable on the credit limit is analyzed. Variable No.5 represents the average card utilization ratio. Regular variables are used to generate dummy variables 6-10. They were originally written answers that were turned into numbers using the Stata software to represent different responses in the variables. For example, the dummy variable generated from the gender answer, gender_dum = 1, indicates that this variable represents the male. Similarly, 0 indicates female. The different numbers in other variables also have corresponding interpretations. As expected, the customer age has a quadratic influence on their credit limit. It means that both

younger and older card holders have lower credit limit while the middle-aged ones have a higher tendency to get more credit limit.

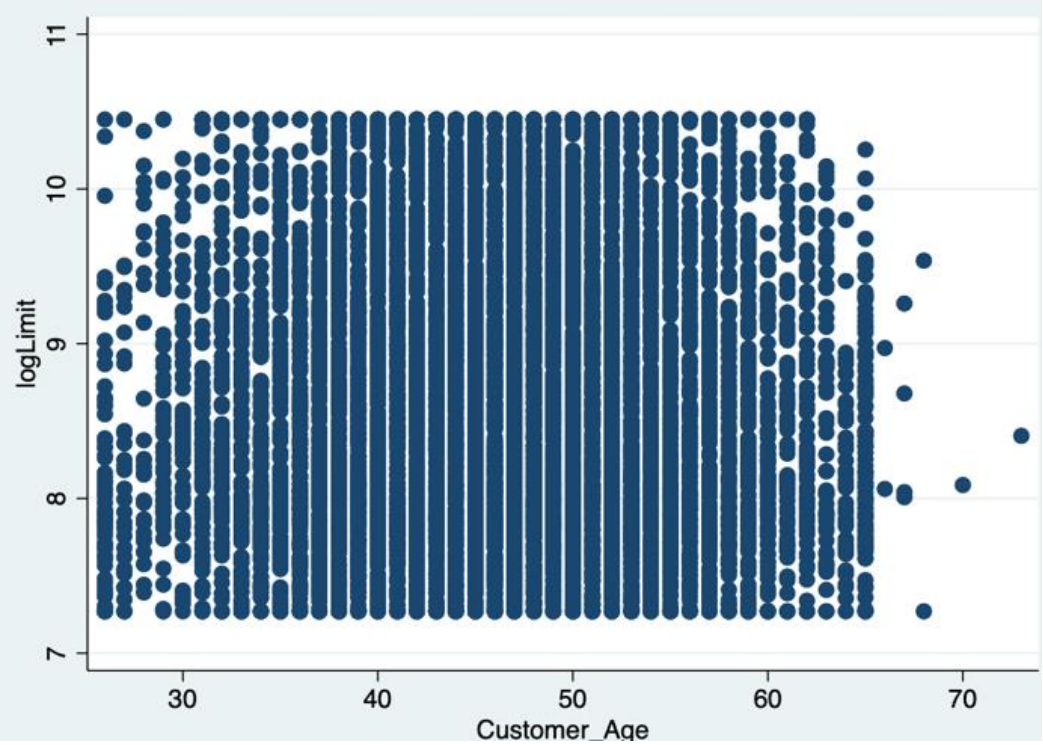


Figure 2. Scatter Plot of log (credit limit) as a function of Age of Bank Holders

2.2. Model

In this paper, 6 regression models are constructed for age (Model 1); age and average card utilization ratio (Model 2); age, average card utilization ratio, gender and education level (Model 3); age, average card utilization ratio, gender, education level, marital status and income (Model 4); age, average card utilization ratio, gender, education level, marital status, income and customer's card type (Model 5); age, average card utilization ratio, gender, education level, marital status, income, customer's card type, and age square (Model 6). The expressions of the 6 models are given as follows.

$$logLimit = \beta_0 + \beta_1 \times customer_age + u \quad (1)$$

$$logLimit = \beta_0 + \beta_1 \times customer_age + \beta_2 \times avg_utilization_ratio + u \quad (2)$$

$$logLimit = \beta_0 + \beta_1 \times customer_age + \beta_2 \times avg_utilization_ratio + \beta_3 \times (gender_dum) + \beta_4 \times (educ_dum) + u \quad (3)$$

$$logLimit = \beta_0 + \beta_1 \times customer_age + \beta_2 \times avg_utilization_ratio + \beta_3 \times (gender_dum) + \beta_4 \times (educ_dum) + \beta_5 \times (marital_dum) + \beta_6 \times (income_dum) + u \quad (4)$$

$$logLimit = \beta_0 + \beta_1 \times customer_age + \beta_2 \times avg_utilization_ratio + \beta_3 \times (gender_dum) + \beta_4 \times (educ_dum) + \beta_5 \times (marital_dum) + \beta_6 \times (income_dum) + \beta_7 \times (card_dum) + u \quad (5)$$

$$logLimit = \beta_0 + \beta_1 \times customer_age + \beta_2 \times avg_utilization_ratio + \beta_3 \times (gender_dum) + \beta_4 \times (educ_dum) + \beta_5 \times (marital_dum) + \beta_6 \times (income_dum) + \beta_7 \times (card_dum) + \beta_8 \times agesq + u \quad (6)$$

Here, customer_age is the age of each customer. Avg_utilization_ratio is the average money used per month in the percentage of the credit limit of the card. Gender_dum is the gender of the customer, using 0 and 1 to represent female and male, respectively. Educ_dum is the education level of the customer, using 1-7 to represent education level, from middle school to PhD. Marital_dum is the marital status of the customer, using 1-4 to represent different status, single, married, divorced and

widow respectively. Income_dum is the income level of the customer, distributing different annual income level into 6 categories, each represented by different numbers from 1-6. Card_dum is the card type of the customers, representing their relationship with the bank using number 1-4. The agesq is the square term of the customer age, in order to analyze the quadratic relationship of the customer age and credit limit of the customer.

3. Results & Discussion

In Table 2, each model adds more variables into the previous regression model, so as to study the impact of additional variables on the credit limit. It can be seen from Model 1-6 that customer age has a positive impact on the credit limit. The most complete model 6 has the largest coefficient corresponding to age, showing that a 1.76 percentage change in credit limit is associated with the card holder's age being one year older. P-value < 0.05 also shows that the result is statistically significant. The square of age has a negative coefficient that is very small show that age has a negative quadratic relationship with the credit limit. This can be explained by elder people generally having higher income and the ability to pay back the money they owe. However, people too old may be assumed that they are accompanied with a higher risk of diseases and their credit limit is lower.

Table 2. STATA data analysis result

	Eq. (1)	Eq. (2)	Eq. (3)	Eq. (4)	Eq. (5)	Eq. (6)
customer_age	0.00046	0.00091	0.0015	0.000081	0.00074	0.0176**
avg_utilization_ratio		-1.82***	-1.52***	-1.29***	-1.07***	-1.07***
0.gender_dum			0	0	0	0
1.gender_dum			0.63***	0.19***	0.18***	0.19***
1.educ_dum			0	0	0	0
2.educ_dum			-0.0068	-0.022	-0.014	-0.016
3.educ_dum			0.030	0.044	0.040	0.039
4.educ_dum			0.025	0.030	0.039	0.039
5.educ_dum			0.040	0.062	0.053	0.053
6.educ_dum			0.046	0.042	0.050	0.049
7.educ_dum			0.011	0.021	0.027	0.027
1.marital_dum				0	0	0
2.marital_dum				-0.097***	-0.087***	-0.087***
3.marital_dum				-0.031	-0.048	-0.045
4.marital_dum				-0.011	-0.034	-0.036
1.income_dum				0	0	0
2.income_dum				-0.92***	-0.91***	-0.90***
3.income_dum				-0.57***	-0.56***	-0.56***
4.income_dum				-0.23***	-0.21***	-0.21***
5.income_dum				-1.07***	-1.05***	-1.04***
6.income_dum				-0.52***	-0.49***	-0.47***
1.card_dum					0	0
2.card_dum					1.25***	1.25***
3.card_dum					1.30***	1.30***
4.card_dum					1.16***	1.16***
agesq						-0.00018*
_cons	8.58***	9.06***	8.63***	9.60***	9.42***	9.03***

* p<0.05, ** p<0.01, *** p<0.001

To analyze the effect of average card utilization ratio, models 2-6 were used to figure out that the average card utilization ratio has a negative impact on the credit limit. Model 6 shows that a 1.07 percent decrease in the credit limit is associated with the utilization ratio increase by 1 percent, and

the result is statistically significant. This could be explained by people who always use up their credit limit would be assumed to have the tendency to overuse their money. Thus, the institutes would give them less credit limit according to this situation. The coefficients appearing in each model indicate that the other variables produce omitted variable bias downward for this variable.

From models 3-6, one can figure out that males generally have a higher credit limit. The complete model shows that on average males have an 18.9 percent higher credit limit compared to females, and the result is statistically significant. This can be related to gender discrimination, the assumption that men are better at earning money and repaying loans, and that many women are unemployed. The coefficients appearing in each model indicate that the other variables ultimately produce omitted variable bias upward for the gender variable. For example, when exclude the income variable, the income difference can be attributed to the gender variable.

The complete model shows that the doctoral degree harms credit limit compared with a college degree. Other kinds of degrees all have a positive effect on the credit limit. A p-value higher than 0.05 implies that the results are not statistically significant. In that way, the impact of education is limited in this model. In addition, it indicates that married people have an 8.7% lower credit limit compared with divorced ones. Single people and those whose marital statuses are unknown also have less credit limit, with no statistical significance. The model also shows that people with the highest income have the highest credit limit, and those with the least income have a 103.6% lower credit limit. The intermediate-income- level people have 89.7%, 56.0%, and 21.0% lower than the highest category as the income level increase. This could be explained by high-income people having a higher ability to pay back their loans. All the percentages written before are statistically significant. The model exhibits that the credit limit increased by 116.2%, 125.0%, and 129.7%, respectively. Results are statistically significant. This is reasonable because for people with higher card level, the bank already assumed they are more financially capable and are highly connected to the bank. It will be willing to give them a higher credit limit.

4. Limitations & Prospects

Nevertheless, this study has some shortcomings and defects. The limitations of this experiment are as follows. Primarily, the credit card holders' debt records are not available. This record can have a big impact on the amount of credit banks extend to cardholders [10], as they will be more likely to trust those with a good record to repay their debts on time. The absence of this variable in the data analysis may lead to the influence of omitted variable bias on other variables, which reduces the accuracy of the research results. Besides, in the experiment, many variables are dummy variables, in which successive different numbers represent the actual results. If some of these variables (e.g., income) could be accurate numerical results, the accuracy of the results might be improved.

Further research could be guided by this study with more variables to analyze and using direct data to obtain more precise regression formulas. In some countries, credit cards are issued with more stringent conditions. This study may help people who do not have access to credit cards to assess their future credit limits in advance, or for companies that offer rental services for reference.

5. Conclusion

In summary, this paper investigates credit card limit based on variables of the customers of the bank. Specifically, whether the age, utilization ratio of the card, gender, marital status, education background and card type influence the credit limit, and by how much. As credit cardholders age, the amount of credit that banks give them generally rises, but extreme age data (too old or too small) can lead to a decline in credit limit. Other variables that can be strongly demonstrated to have an impact on credit limits include average card utilization ratio, gender, marital status (divorced), income, and card type. Nevertheless, more precise information of the credit card holders is required to acquire a more specific regression model. In the future, experts and companies could use this model to develop

or improve their related system. Overall, these results offer a guideline for the credit evaluation industry.

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