

Risk and Revenue Management in the Chinese Auto Loan Industry

Jianping Peng, Sun Yat-sen University, China & Guangzhou Xinhua University, China


Wanli Liu, Sun Yat-sen University, China & Guangzhou Xinhua University, China

Zhenheng Huang, Guangzhou Xinhua University, China*

Dongmei Xu, Guangzhou Xinhua University, China

Qinglei Cai, Southern Medical University, China

Jing Quan, Salisbury University, USA

 <https://orcid.org/0000-0002-5318-809X>

ABSTRACT

The automobile consumption credit business promotes the development of the automobile industry. However, the current credit system in China requires further refinement. Thus, the credit loan business is associated with certain risks, and company profits are often negatively impacted by clients who default on loans. Based on the data, this article leverages the economic and financial theories of consumer credit risk control to construct a logistic model to predict customers' default probability. Then, a quadratic regression model is established to determine the optimal commission structure to balance profitability with incentives from retail stores. Results show that the macro-level variables are negatively associated with the probability of good behavior. The personal level variables exhibit a positive association. In addition, a negative coefficient in the quadratic profit equation indicates the presence of an inverted "U" relationship between profit and commission. Corresponding suggestions are put forward.

KEYWORDS

Car Credit, Credit Default, Profit and Commission, Risk Control, Sustainable Marketplace

INTRODUCTION

Automobile consumer credit is extremely popular in developed countries like those in Europe and North America. Specifically, credit plays a significant role in the development of passenger cars while also generating significant profits for financial institutions that offer such credit products. With the rapid development of China's economy, automobiles have gradually become an important form of durable goods in everyday life. In recent years, consumer demand for automobile credit has increased, with many consumers preferring to purchase a new car on credit.

DOI: 10.4018/IRMJ.323438

*Corresponding Author

This article published as an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.

However, the Chinese automobile consumer credit industry is still in its infancy, with an evolving management system and no personal credit system. As a result, both commercial banks and financial companies that issue car credit face sizeable default risk. Inadequate research of traditional automobile finance companies' risk controls has created many loopholes in the control mechanisms of automobile loans.

Another risk for financing companies is the excessive cost of commissions paid to retail stores. It should be noted that inadequate commissions may lead salespeople to reduce their efforts. As such, determining the optimal commission has become a risk-reducing action for vehicle financing companies. Accordingly, academics and professionals seek to construct an effective evaluation system based on historical data and customer behavior to minimize default risks and develop a balanced commission strategy in China.

In terms of existing risks and problems associated with automobile consumer credit default, this study provides theoretical guidance and empirical evidence for automobile financing companies to guide them in designing a balanced commission structure and identifying customers who will pay back the loan on time. The research helps companies identify desirable customers, determine the optimal amount of commission to be paid, and maintain a sustainable business. The present study answers the following two research questions:

1. What factors are associated with on-time repaying behavior?
2. What constitutes a balanced commission structure between finance companies and retail stores?

By leveraging economic and financial theories of consumer credit risk control, the authors first established a logistic model to predict the probability of a "good" customer (i.e., an individual who will repay on time, payoff, or payoff early) based on both macro- and micro-level factors. Abnormal execution status is defined under two circumstances. First, the borrower does not repay the loan on time under the grace period specified by the terms. Second, civil proceedings have been brought to court. The macro-level factors include the sale price, loan amount, interest rate, and contract length. Meanwhile, the individual level variables include age, marital status, education, and home ownership. Additionally, the authors constructed a quadratic regression model to determine the optimal commission structure that balances profitability with incentivizing the retail store staff.

This study compiled 129,858 transactions carried out by a Chinese consumer automobile credit company. The results show that the macro-level variables are negatively associated with the probability of good behavior, whereas the personal level variables exhibit a positive association. A negative coefficient for the commission squared in the quadratic profit equation indicates that the relationship between the profit and commission forms an inverted "U" shape. This provides a theoretical foundation for the optimal commission amount for maximum profit. The result of the study enables 4S (sales, spare parts, service, and survey) stores in undeveloped, developing, or developed countries to address issues related to credit risk. Relevant issues include finding factors connected with credit risk and determining an optimal commission amount for maximum profit. Further contribution will be explored in the discussion and conclusion sections.

The article is organized as follows. Section two summarizes the related works. Section three elaborates on the research questions, outlines the data collection process, and proposes empirical models to explore the research question. The model estimations, analysis, and discussions are presented in section four. Two extended models to incorporate monthly data and keywords search frequency are investigated in section five. Finally, section six concludes with the results and limitations of the present study and future research directions.

LITERATURE REVIEW

Risk control for automobile consumer credit companies has been generating a great amount of interest among scholars. For example, Stiglitz and Uy (1996) suggested that credit risk is widespread

in the automobile consumer credit business. Perfecting a personal credit system is a prerequisite for developing an automobile credit business. In their study of the automobile consumer credit market, Harris and Wilson (2010) concluded that the risk of automobile consumer credit is closely linked with information asymmetry. Meanwhile, Rejda and McNamara (2014) analyzed three kinds of risk in the automobile consumer credit market: (1) operational risk of financial institutions' internal employees; (2) personal credit risk; and (3) market risk. They proposed that the risks are unavoidable, and the associated losses are uncertain; therefore, it is necessary to guard against risk by relying on relevant experience and data analytics.

Besides the research conducted on the importance and origin of risk control for automobile consumer credit, scholars also explored the relationship between automobile credit consumption and credit risk. Zhang (2008) summarized the experience of the rapid development of American automobile consumer credit, finding that leading consumer awareness, government support, diversified consumer credit institutions and services, and individual credit evaluation systems are important for promoting the development of automobile credit consumption. Xiong and Kuang (2015) took the Industrial Bank's Guangzhou branch of the automobile consumption credit business as a case study to analyze the development of the automobile consumer credit market. They found that the marketing concepts and implementation of the various means of risk prevention and control are crucial to promoting the long-term development of automobile consumer credit. Jiang et al. (2021) studied how consumers who receive a bonus can have an impact on consumer demand for auto loans and the subsequent risk of loan delinquency. It was found that receiving a bonus raises auto loan demand by 21%; however, the corresponding risk of the borrower not fulfilling their credit responsibilities increases at the same time.

The current research focuses on the importance, general sources, and causes of auto consumer credit risk, as well as its relationship with auto consumer credit consumption. These aspects of credit risk are essential. However, the need to study root causes of auto credit risk is also crucial to credit risk mitigation. Thus, this article studies the root causes by analyzing the factors associated with default behavior.

Models required for further analysis have been proposed and compared. Saunders and Allen (2002) compared several credit risk quantifying methods and identified the respective advantages and disadvantages of each method. Zafra-Cabeza et al. (2011) put forward a stratification-based risk control measure model. Netjasov (2012) proposed an evaluation method specifically for conflict risk assessment. Models relating to factors association analysis with credit risk have also been proposed. Peng et al. (2017) applied the logit model and Bayesian model in their research to find factors' correlation and estimated conditional probability. Henning and Jordaan (2016) researched the factors affecting the ability of farmers to repay loans from commercial credit providers. The independent variables in the study included account standing, age, client success factor, collateral, credit record, education level, and reputation. Moreover, Chamboko and Bravo (2016) applied models to assess the prognoses (from delinquency to normal performance) of retail customers' loans. They discovered that behavioral variables were the most important when discerning the recovery of funds patterns of borrowers.

Risk prevention models to identify lending risks and lending decisions have also been proposed (Myers & Forgy, 1963; Sharpe, 1964). Among them, Altman (1968) put forward a multivariate Z scoring method analysis model in the 1970s, also known as the Zata model. The model is typically used to calculate the powers of the warning function of various financial ratios when predicting financial crises as weights and to calculate a comprehensive risk level "Z" using weighted averages for an enterprise. The Z values are compared with the critical value to determine a company's risk level. Banks use this method to evaluate customer lending risks (Altman, 1968). Xiang (2002) discussed business operation risk by using the Zata model and demonstrated its effectiveness.

The logit model and Bayesian network model are effective in exploring the correlation relationship and probability estimation. Li and Li (2012) used a dynamic game model with incomplete information to analyze the gaming behaviors between banks and consumers in the Chinese automobile consumption credit market's current stage of development and were able to determine areas needing improvement. Chi and Meng (2019) proposed a loan scoring model to identify different default situations for small

industrial enterprises. The model is based on the method of F-test and correlation analysis. Tzerjan et al. (2021) developed a hybrid model for credit scoring in complex systems, which they then used to detect suspicious customers who may not repay their loans on time. This allowed financial institutions to utilize the model to avoid customers who would likely default. Fernando and Siagian (2021) proposed conducting an analysis by integrating the five Cs model (character, capacity, conditions, capital, and collateral) and the analytic hierarchy process (AHP). The results of the analysis were used to provide guidance for credit decision making.

Current research has proposed many models, most of which are associated with risk prevention. Association analysis models of credit risk factors in other industries are discussed. Still, research is needed in the automobile consumption industry. Therefore, this article introduces empirical, risk, and logit models to analyze the credit risk factors.

Some scholars conducted detailed analysis on the relationship among certain independent variables and credit default behavior. In China, scholars (e.g., He, 2014; Jiang, 2016) have reviewed the current automobile consumer credit situation and identified the problems in aspects like legal implications, insurance, dealerships, and social credit scoring system. They accordingly proposed corresponding countermeasures. Wu et al. (2018) conducted empirical research on stress testing for automobile loans, finding that the automobile default probability may increase as the loan term increases. Related research was conducted in other countries. For example, Liu (2012) found a similar conclusion when they studied the effect of United States regulations on credit risk controls. Wadud et al. (2020) studied the impact of consumer sentiment on the delinquency of household credit, including home ownership, credit card, and automobile loans in the U.S. As overall consumer sentiment increases, the loan delinquency rate also increases. Regarding automobile loans, individuals who are more confident tend to decrease automobile loan delinquencies. An increase in expected individuals' sentiments tends to increase loan default rates (Wadud et al., 2020). Cyree (2021) analyzed delinquency data from 2003 to 2017, finding that auto loan delinquencies are positively correlated with bank loan delinquencies. Frydman et al. (2021) focused on creditworthy borrowers as a group. They examined their determinants, mostly the macroeconomic variables. In the study, the mover stayer model was applied. The results indicate that annual growth domestic product (GDP) growth was the only macroeconomic variable to substantially affect the creditworthy borrowers' probability. Research related to changes in collateral value affecting borrowers' default outcomes has also been conducted, showing that a drop in collateral value will give rise to an increased default rate and vice versa (Ratnadiwakara, 2021).

Overall, specific macro- and micro-level independent variables were studied. Macro-level variables like regulations, GDP growth, and credit systems were found to correlate with credit default behavior. Micro-level variables like consumer sentiment, loan term, and home ownership are associated with the behavior. More variables and their impacts should be further studied.

Based on the data of this article, the authors were able to find additional variables and their correlation with lending risks. The relationship between commission and lending risk is also discussed.

A review of the existing literature has shown that understanding the factors that cause credit delinquency is of vital importance when assessing the credit default rate of customers. Moreover, the credit risk control ability of automobile credit is the core competence of banks and credit firms. Further studies are needed, however, to validate the relevant theories and identify the key factors related to lending risks. The existing research focuses on either credit risk control in different fields or analyzes the relationship between companies' credit risk variables and firm profit. Even though some scholars conducted research on risk control in terms of automobile consumption credit, the corresponding empirical research has yet to be conducted. Therefore, this study focuses on identifying logical relationships between customer credit risk variables and firm profit through data mining techniques. In addition, the study focuses on the field of automobile consumption credit, suggesting corresponding strategies for companies to control risk and remain sustainable in the marketplace.

METHOD

The practical approach adopted when granting credit in the banking industry is known as the five C's of good lending practices (Brody & Frank, 1998): (1) character; (2) capacity; (3) conditions; (4) capital; and (5) collateral. These represent the core of sound lending practices, which lenders deploy to evaluate a borrower along the dimensions of the borrower's reputability, ability to repay the loan, adequacy of capital, and collateral backing up the loan (Golden & Walker, 2012). The five C's model is frequently applied when researching credit firms and companies' credit risk variables.

Character refers to the borrower's sense of responsibility. The bank can use past repayment records to determine a borrower's quality. Assessing the quality of a borrower's character includes evaluating their honesty, stability, and integrity, as well as their personal and professional credentials (Brody & Frank, 1998).

Capacity refers to the borrower's ability (capacity) to repay the loan. Lenders need to understand the current risk associated with the borrower and be able to anticipate future risk. Conditional evaluation requires an appraisal of the borrower's business and economic conditions.

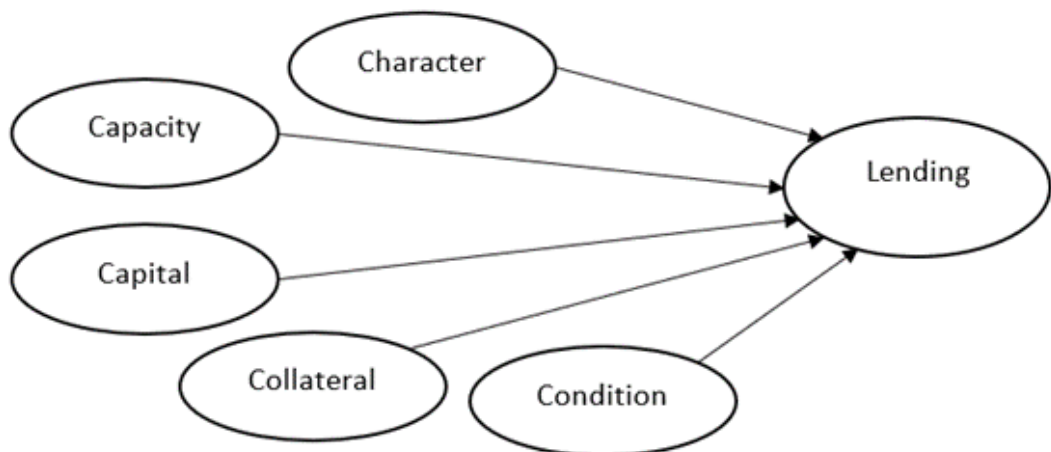
The borrower's capital and collateral refer to their cash, cash flow, assets of value, and the net worth of the borrower when applying for a loan. Adequate capital is needed to provide a buffer in case of a future loss of income. In case of default by the borrower, the bank will have tangible assets that can be sold to cover losses.

When a borrower completes an application for a loan, either a bank loan officer or loan committee reviews the loan application and will evaluate it by referring to the five C's. After analyzing the necessary information, a decision is made to either grant or deny the loan.

Tezerjan et al. (2021) also applied the five C's concept to classify customers' attributes and score customers. Specifically, character contains credit history, deferred claims, experience, specialty, education, and fame. Capacity includes debt and income. Capital includes an average balance of the account, sales, profit, fixed assets, and current assets. Collateral includes immovable property, long-term deposits, bonds, checks, receipt documents, and stocks. Conditions include supply-to-demand ratios and type of activity section.

Based on this description and gathered data, it can be concluded that age and marital status belong to character, loan amount and interest rate are included in capacity, education belongs to capital, real estate holdings belong to collateral, and local GDP per capita is included in condition.

Figure 1. Five C's of credit



Data Collection and Correlation Analysis

The data in this article is derived from car loan company A. A total of 129,858 data points were collected from the company’s sales database relating to all family car loans sold across the country. Data acquisition comes from first-hand data of a Chinese company. The data was collected from salespeople working in the company. When salespeople in 4S stores sign contracts with customers, all information related was filled out on the form. The customers’ information was input into the computer system. Table 1 shows the definitions and descriptions of the research variables and their descriptive statistics, respectively.

The authors used SPSS tools to standardize the collected data and perform a correlation analysis. Table 2 shows that the company’s profit is related to the type of car purchased by the customer, number of loans, commissions, and customer attributes.

Empirical Models

There are two issues that require clarification in the study of auto credit projects. What factors affect the loan risk? How is the risk controlled? There is pervasive information asymmetry in this market. Thus, the loan company does not have access to accurate credit information pertaining to the customers and has poor visibility of potential fraudulent behavior. This leads to loan recovery risks. Therefore, constructing related models to find causal relationships is key to reducing risks through institutional design. Moreover, it is important to discern the factors related to company profits and maximize profits while controlling risks.

Based on the company’s historical data, the following two models were constructed to explore the research questions. Regarding risk control, there are normal and abnormal contracts. Normal contracts refer to the correct implementation, regular loan repayments, and early loan repayments (see logistic regression model [1]). The key factors affecting the company’s income are discussed using the linear regression model (2). The independent variables of the two models are the same. The specific models are presented as follows:

$$\text{logit} \frac{P}{1-p} = \beta_0 + \sum_k \beta_k x_k \quad (1)$$

Table 1. Description of variables

Variables	Description of Variables
Profit	Net profit the company earns after the sale of one vehicle
Contract Condition	Contract either normally or incapably fulfilled
Contract Terms	Months or years to fulfill the contract
Automobile Price	Amount of money to buy a car
Loan	Amount of money required to apply for an automobile loan
Interest Rate	Interest the customer pays on the loan
Total Interest	Total of both bank and company’s interest
Commission	Money requested by distributor who sold the vehicle
Age	Customer’s age
Education	Degree of literacy
Real Estate Holdings	Assessment evaluating the condition of the house owned by customer

Source: Actual Operation Data from Company A

Table 2. Correlation analysis

	y	x1	x2	x3	x4	x5	x6	x7	x8
Net Profit (y)	1								
Automobile Price (x1)	.557**	1							
Loan Amount (x2)	.771**	.842**	1						
Interest Rate (x3)	.568**	.069**	.287**	1					
Commission (x4)	.373**	-.017**	.066**	.470**	1				
Age (x5)	.109**	.176**	.166**	-.010**	.004	1			
Education (x6)	-.030**	.072**	.025**	-.139**	-.092**	-.117**	1		
Real Estate Holdings (x7)	.041**	.075**	.055**	-.099**	.013**	.228**	.155**	1	
Contract Terms (x8)	.722**	.142**	.419**	.656**	.246**	-.001	-.047**	.003	1

Note. Results in Table 2 show that the correlation coefficients of auto price, loan amount, interest rate, dealer commission, age, real estate holdings, and contract terms are 0.557, 0.771, 0.568, 0.373, 0.109, 0.776, 0.041, and 0.722, respectively, indicating positive correlation at the level of 0.01. Among them, auto price, loan amount, interest rate, and contract terms are closely correlated with corporate profit. In addition, the correlation coefficient between education and profit is -0.03, indicating a negative correlation.

**Represents a significance at the level of 0.01.

$$y = \beta_0 + \sum_k \beta_k x_k \tag{2}$$

where p is the probability of the normal implementation of the contract, y is the income of each loan contract of the company, and $x1$ to $x8$ represent the variables in Table 2.

FINDINGS

Risk Model

The authors first performed logit regression on the normal execution status and abnormal status of the past contracts (see Table 3). Coefficients of Beta and Sig show the correlation and significance for the variables. The normal execution probability of the company’s auto loan contract is significantly positively correlated with car price, education, and age. It is significantly negatively correlated with loan amount, commission, and contract terms.

Table 3. Risk model estimation

	β	S.E.	Sig.	Exp (β)
Automobile Price	.569	.103	.000	1.767
Loan Amount	-.903	.105	.000	.405
Interest Rate	-.140	.072	.054	.870
Commission	-.223	.024	.000	.800
Age	.129	.044	.003	1.138
Education Assessment	.097	.041	.019	1.102
Real Estate Holdings	.053	.042	.202	1.055
Contract Terms	-.197	.049	.000	.821
Constant	5.594	.050	.000	268.777

The biggest risk associated with an auto loan is that the customer will not repay it (i.e., the contract is not executed as intended). This outcome may cause the loan company to suffer huge losses. General customers can be divided into two categories. The first type of customer is ill-informed about the maintenance cost of the car after purchase. After borrowing funds to purchase a car, they realize that they cannot afford it. Another type of customer consciously commits fraud. Table 3 shows that the salient factor that increases the probability of default is the loan amount, followed by the loan company's commission. It is understandable that a larger loan amount increases the risk of default. If the loan company's commission is set too high, the incentives for the sales force will increase sales as they try to meet the demands of customers without seriously identifying risks. These result in a decrease in the probability of execution of the final credit contract.

The higher the price of the car, the greater the probability that the contract will be executed. This is because customers are less likely to skip the large down payments on expensive cars. This also depends on the number of loans from the customer. In addition, the customer's education and age increase the likelihood of executing the contract for the purchase of the car (i.e., older, more educated consumers are likely to execute the terms of the loan). Meanwhile, whether the customer has real estate holdings is not significantly correlated with the execution of the car purchase contract.

Profit Model

The main way to improve the company's performance is to encourage more customers to take out loans to purchase cars. Under the premise of controlling risks, the factors that impact a company's profits and their related weights need to be identified. Table 4 details the linear regression parameter estimation of model (2).

The results in Table 4 demonstrate that the explanatory power of the independent variables in relation to the dependent variable is 90%. VIF < 10 indicates no multivariate collinearity between the independent variables. The correlation between profit and the amount of customer interest is the highest, followed by the loan amount, and the contract length. While individual attributes are significantly correlated with the company's profit, the coefficients are small.

The commission paid by the loan company to the dealer has a significant correlation, indicating that the more the commission paid by the loan company, the higher the enthusiasm of the car salespeople to promote sales. Higher commission payments, however, may also reduce the execution

Table 4. Model (2) estimation

Variables	Coefficient	VIF
Constant	.000	
Automobile Price	.038***	4.273
Loan Amount	.274***	6.071
Interest Rate	.574***	4.948
Commission	.107***	1.117
Age	.006***	1.057
Education	.002*	1.080
Real Estate Holdings	.013***	2.920
Contract Terms	.132***	4.273
R2	0.900	
F	146484.965***	

Note. ***, **, * represent significance at the level of 0.01, 0.05, and 0.1, respectively.

probability of the contract in our risk model. Therefore, the issue of how to balance a reasonable commission with maximizing the company's profits needs to be further explored.

DISCUSSION

Profit vs. Commission

To clarify the inherent relationship between profit and commission, the amount of commission paid by the loan company and the company's profit were compared using both a linear model and quadratic model. Table 5 shows that commission is significantly correlated with the profits in all models. However, their degrees of goodness-of-fit are different. The R2 of the quadratic model is 23.6% as compared with 13.9% of the linear model. This is an increase of almost 10%. Accordingly, the quadratic model is used to explain the relationship between commission and profit.

The relationship between company profit and commission takes the form of a quadratic relationship. The coefficient of the squared term is negative, indicating that the relationship is an inverted "U" curve. This shows that the company's profit initially increases with commission. It then plateaus and starts to decline. This is consistent with the finding in Table 3. The probability of execution of loan contracts reduces as commission increases. Hence, from the perspective of total profit, it is important to strike a balance between the commission structure and risk control.

Loan Strategy

Although car purchase by credit is both attractive to customers and a potential source of profit for the loan company, the existence of the risk of customer default makes it important for the company to identify whether the customer can repay the loan. The risk model put forward in the present study shows that issuing loans to highly educated and older aged customers can significantly increase the probability of normal contract execution, indicating that such customers have a lower risk of default. The company should implement differentiated interest rates for this group of people and encourage them to take out loans to purchase cars. For customers in this category who are not willing to increase the down payment for high-priced cars, the company needs to offer them special considerations and identify the customers' default probability through increased communication.

Auto loan companies must rely on 4S stores to expand their business. To entice customers to purchase cars, 4S stores may implement three incentives: (1) maintenance fee after sales; (2) sales profit; and (3) commission from the loan company. Normally, 4S shops are only interested in selling cars, such that it is of no concern to them if the loan can be recovered. To overcome this asymmetry in responsibility, it is important to transfer part of the customer's default risk to the 4S shops and link it with the contract commission for each loan agreement. This can reduce the potential for default. The current loan commission payment mechanism is that each loan contract commission is divided into several levels by the loan company and immediately paid to the 4S shops. A new rule to consider is to only settle the commission with the 4S shops after six consecutive months of the normal contract execution. Adopting this approach shares the loan risks with the 4S shops, which will encourage the employees to be more careful when promoting loan products to customers. In addition, definition of the abnormal execution status of contracts can be incorporated into companies' systems. Once

Table 5. Linear vs. quadratic model

Equation	Model Summary						Parameter Estimation		
	R2	Adjusted R2	F	df1	df2	Sig.	Constant	Profit	Profit2
Linear	.139	.139	20932.026	1	129856	.000	.000	.373	
Quadratic	.236	.236	20059.685	2	129855	.000	.112	.877	-.112

abnormal status signal is triggered, companies should begin to analyze factors causing the abnormal status and collect related information for future risk control.

The profit of a loan company is derived from the number of loans it makes and the interest rates it charges and collects. Due to the disclosure of bank interest rate and loan interest rate information, loan transactions with exceedingly high interest rates are unlikely to occur. Therefore, one way to increase the company's profit is to expand the market and control risks, and rationally customize commission expenses where appropriate. The inverted U-shaped curve relationship between commissions and profits indicates that a company that pays excessive commissions does not obtain corresponding profit returns. The current commission structure means that the amount is the same within the range of loan sales and increases linearly as the range moves up. This creates the false sense that more loans lead to a greater commission. This, in turn, increases the risk of credit abuses and defaults. Therefore, it is important to take the inverted U-shaped relationship into consideration when designing an optimal commission payout structure.

CONCLUSION

This article studies the data of a passenger car credit business. It is found that the probability of car loan contract execution is positively correlated with the customer's education level and age. It is negatively correlated with the commission paid by the loan company to the 4S store and the number of loans provided by the lender. Meanwhile, the profit obtained from the loan is positively correlated with the variables described. The need for front line employees to carefully consider balancing profits and risks has been outlined. At the same time, loan companies need more refined incentive commission structures to achieve a win-win situation with the retail car store. Based on the result, 4S companies can categorize customers into different risk groups and create corresponding credit contracts to mitigate credit risk.

Due to the lack of access to customers' personal attribution data, the authors cannot make more reasonable and effective judgments in identifying customer individuality. The main reason is that 4S stores do not care to collect complete customer information as to who they are and what their characteristics are. Their goal is to make sales and receive the related commission. Moreover, other variables (i.e., jobs, number of children, and working industries) can be further analyzed if these data can be collected by other researchers. Future studies should look at how to construct a new commission mechanism to encourage employees to interact more with customers and identify those customers who are a better credit risk.

ACKNOWLEDGMENT

Competing Interests

The authors report there are no competing interests to declare.

Funding Agency

This research was funded by National Natural Science Foundation of China under grant number 71572196.

REFERENCES

- Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589–609. doi:10.1111/j.1540-6261.1968.tb00843.x
- Argyle, B., Nadauld, T., Palmer, C., & Pratt, R. (2021). The capitalization of consumer financing into durable goods prices. *Journal of Finance*, 76(1), 169-210. ehttps://10.1111/jofi.12977
- Brody, R. G., & Frank, K. E. (1998). The sixth C of credit. *Journal of Performance Management*, 11(3), 46–56. https://www.proquest.com/docview/214035327?pq-origsite=gscholar&fromopenview=true
- Chamboko, R., & Bravo, J. M. (2016). On the modelling of prognosis from delinquency to normal performance on retail consumer loans. *Risk Management*, 18(4), 264–287. doi:10.1057/s41283-016-0006-4
- Chi, G., & Meng, B. (2019). Debt rating model based on default identification: Empirical evidence from Chinese small industrial enterprises. *Management Decision*, 57(9), 2239–2260. doi:10.1108/MD-11-2017-1109
- Cyree, K. B. (2021). The impact and evolution of consumer delinquencies on bank loan delinquencies. *Managerial Finance*, 47(3), 413–438. doi:10.1108/MF-04-2020-0206
- Fernando, E., & Siagian, P. (2021). Proposal to use the analytic hierarchy process method evaluate bank credit submissions. *Procedia Computer Science*, 179, 232–241. doi:10.1016/j.procs.2021.01.002
- Frydman, H., Matuszyk, A., Li, C., & Zhu, W. (2021). A new framework for examining creditworthiness of borrowers: The mover-stayer model with covariate and macroeconomic effects. *Quantitative Finance*, 21(9), 1491–1499. doi:10.1080/14697688.2021.1917773
- Golden, S., & Walker, H. M. (2012). The ten commandments of commercial credit: The ‘Cs’ of good and bad loans. *The RMA Journal*, 94(9), 42-46. https://www.proquest.com/docview/1039695514
- Harris, D., & Wilson, A. (2010). Drought ends: Average Joe can get a car loan. *Automotive News*, 9(6400), 25–63.
- He, H. (2014, December 30). Attention to risks of automobile credit consumption. *China Urban and Rural Finance News*.
- Henning, J. I. F., & Jordaan, H. (2016). Determinants of financial sustainability for farm credit applications: A Delphi study. *Sustainability (Basel)*, 8(1), 77. doi:10.3390/su8010077
- Jiang, M. (2016). The condition and strategies of automobile credit consumption in China. *China Credit Card*, (3), 57-60. http://www.cnki.com.cn/Article/CJFDTotal-XYKZ201603016.htm
- Jiang, Z., Zhang, D. J., & Chan, T. (2021). How do bonus payments affect the demand for auto loans and their delinquency? *JMR, Journal of Marketing Research*, 58(3), 476–496. doi:10.1177/00222437211009214
- Li, L. P., & Li, Y. H. (2012). Game theory analysis on the incomplete information of automobile credit consumption. *Friends of Accounting*, (7), 43–46. doi:10.3969/j.issn.1004-5937.2012.07.013
- Liu, B. (2012). Enlightenment of automobile credit consumption laws and regulation in America to China. *Auto Industry Research*, (4), 35–37. doi:10.3969/j.issn.1009-847X.2012.04.012
- Moula, F. E., Guotai, C., & Abedin, M. Z. (2017). Credit default prediction modeling: An application of support vector machine. *Risk Management*, 19(2), 158–187. doi:10.1057/s41283-017-0016-x
- Myers, J. H., & Forgy, E. W. (1963). The development of numerical credit evaluation systems. *Journal of the American Statistical Association*, 58(303), 799–806. doi:10.1080/01621459.1963.10500889
- Netjasov, F. (2012). Framework for airspace planning and design based on conflict risk assessment: Part 2: Conflict risk assessment model for airspace tactical planning. *Transportation Research Part C, Emerging Technologies*, 24, 213–226. doi:10.1016/j.trc.2012.03.003
- Peng, J., Qu, J., Peng, L., & Quan, J. (2017). An exploratory study of the effectiveness of mobile advertising. *Information Resources Management Journal*, 30(4), 24–38. doi:10.4018/IRMJ.2017100102
- Ratnadiwakara, D. (2021). Collateral value and strategic default: Evidence from auto loans. *Journal of Financial Services Research*, 59(3), 209–240. doi:10.1007/s10693-021-00350-3

Rejda, G. E., & McNamara, M. J. (2014). *Principles of risk management and insurance* (12th ed.). Pearson Education Limited.

Saunders, A., & Allen, L. (2002). *Credit risk measurement: new approaches to value at risk and other paradigms* (Vol. 71). John Wiley & Sons.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance*, 19(3), 425–442. doi:10.1111/j.1540-6261.1964.tb02865.x

Stiglitz, J. E., & Uy, M. (1996). Financial markets, public policy, and the East Asian miracle. *The World Bank Research Observer*, 11(2), 249–276. doi:10.1093/wbro/11.2.249

Tezerjan, M. Y., Samghabadi, A. S., & Memariani, A. (2021). ARF: A hybrid model for credit scoring in complex systems. *Expert Systems with Applications*, 185, 115634. doi:10.1016/j.eswa.2021.115634

Wadud, M., Ali Ahmed, H. J., & Tang, X. (2020). Factors affecting delinquency of household credit in the U.S.: Does consumer sentiment play a role? *The North American Journal of Economics and Finance*, 52, 101132. doi:10.1016/j.najef.2019.101132

Wang, D., & Xu, B. (2014). Characteristics and trend toward automobile credit consumption in the first-tier cities. *Auto Review*, (4), 100-103. <http://www.cnki.com.cn/Article/CJFDTotat-QCZH201404019.htm>

Wu, D., Fang, M., & Wang, Q. (2018). An empirical study of bank stress testing for auto loans. *Journal of Financial Stability*, 39, 79–89. doi:10.1016/j.jfs.2018.09.005

Xiang, D. W. (2002). An empirical study on appraisal of listed companies' operation risk by Z Score Method. *Accountability in Research*, (11), 53–57. doi:10.3969/j.issn.1003-2886.2002.11.011

Xiong, C. Y., & Kuang, D. (2015). Marketing strategy analysis for automobile credit consumption business example by industrial bank Guangzhou branch. *China Market*, (34), 62–65. doi:10.13939/j.cnki.zgsc.2015.34.062

Zafra-Cabeza, A., Maestre, J. M., Ridao, M. A., Camacho, E. F., & Sánchez, L. (2011). A hierarchical distributed model predictive control approach to irrigation canals: A risk mitigation perspective. *Journal of Process Control*, 21(5), 787–799. doi:10.1016/j.jprocont.2010.12.012

Zhang, X. Q. (2008). American automobile consuming loaning development's inspiration to China. *Special Zone Economy*, (2), 93–94. doi:10.3969/j.issn.1004-0714.2008.02.031

Jianping Peng is a Professor in School of Marxism, Sun Yat-sen University. He hosted and participated in a number of National Natural Science Foundation of China and National Social Science Foundation. And he is a communication review expert for the National Natural Science Foundation of China. He has published nearly 50 papers in Information Systems Research, Decision Support Systems, International of Information Management, International Journal of Hospitality Management, Journal of Industrial Engineering and Engineering Management and Chinese Journal of Management and other important academic journals. Specialization: management science and engineering; social network.

Zhenheng Huang works at School of Management, Guangzhou Xinhua University. He graduated from Foster School of Business, University of Washington. His research interests include management science and engineering, risk management, forecasting method, cross research and innovation and inventory management etc.

Jing Quan is a Professor and Chair in the Department of Information and Decision Sciences in Perdue School of Business at Salisbury University. He holds a Ph.D. from the University of Florida. His research interests include organizational impact of information technology (IT), knowledge management, and IT professional and personnel issues. His work has appeared in such journals as Journal of Management Information Systems, Communications of the ACM, Communications of the AIS, Information Resources Management Journal, International Journal of Information Management, Journal of Global Information Management, and Journal of Computer Information Systems.