



# Identification and Case Analysis of Credit Card Personal Cash out Based on Time Series

Zhang Liwen<sup>1, a</sup>, Zhang Jingwen<sup>1, b</sup>, Yuan Ye<sup>1, c</sup>, Liu Jiaqi<sup>1, d</sup>

<sup>1</sup>Lingnan College, Sun Yat-sen University, Guangzhou, China, 530023

<sup>a</sup>zhanglw37@mail2.sysu.cn, <sup>b</sup>zhangjw259@mail2.sysu.cn, <sup>c</sup>yuany275@mail2.sysu.edu.cn, <sup>d</sup>liujq99@mail2.sysu.edu.cn

**Abstract.** This paper analyzes the basic situation of credit card cash out and the new way of personal credit card cash out, and proposed a new identification method of the cash out by the model of capital occupancy efficiency through analyzing the time series of the daily total consumption amount. The case is analyzed with this recognition method and the analyzing result shows that the recognition of personal credit card cash out is accurate. The research above has practical significance for strengthening the supervision of credit card and preventing credit card risks.

**Keywords:** Credit Card, Cash Out, Time Series, Case Analysis

## 1 Introduction

As the per capita amount of credit cards in China has been increasing and the user groups of credit cards have been expanding in recent years, the proportion of credit card consumption in the total retail sales of social consumer goods has also been increasing. However, due to the illegal of some credit card holders such as credit card cash out, it has caused new risk impact on credit card business. How to identify cardholders' cash out effectively and strengthen credit card risk management is the focus of credit card supervision at present. The credit card cash out refers to that the card holder use improper and illegal means to withdraw the funds in the form of cash within the credit line granted by the bank but not paying the bank withdrawal fees.

Domestic and foreign scholars have conducted various researches on related issues of credit card cash out. Jiang Sheng proposed a credit card cash-out detection and scoring model based on Logistic regression model <sup>[1]</sup>. Zhou Yang proposed a weighted scoring method based on four variables <sup>[2]</sup>. Jiang Xingbin proposed a customer classification index based on personal credit card consumption analysis <sup>[3]</sup>. Zhao Jing analysed the cause and measure for credit card cash-out behavior <sup>[4]</sup>. Wickramasinghe, V. and Gurugamage, A. elaborated on various types of credit risks that may occur in card issuing banks through cases analysis and made suggestions on risk avoidance <sup>[5]</sup>. LeeCheonWoo and Woo-Hyung, Hong. analysed the credit card income tax has gradually reduced due to the achievement of credit card activation <sup>[6]</sup>.

© The Author(s) 2023

A. Bhunia et al. (eds.), *Proceedings of the 2023 International Conference on Finance, Trade and Business Management (FTBM 2023)*, Advances in Economics, Business and Management Research 264, [https://doi.org/10.2991/978-94-6463-298-9\\_64](https://doi.org/10.2991/978-94-6463-298-9_64)

This paper presents a method of identifying credit card personal cash out based on time series analysis, and analyzes card personal cash out with actual cases.

## 2 The Basic Situation Analysis Of Credit Card Cash Out

The traditional cash out methods of credit cards are as follows:

- (1) Cash out by swiping the card on the POS machine installed by the bank's special merchants;
- (2) Cash out of online consumption;
- (3) Refund the ticket after purchase;
- (4) Cancel after purchasing a large amount of recharge card;
- (5) Cash out of credit card consumption on behalf of others.

These cash out methods are generally provide by professional cash out merchants or companies through creating false transactions generated by cooperating with those merchants or companies. Such cash out methods has a characteristic of large impact to society and involving large scale of personnel and funds since the professional cash out merchants or companies provide these professional services for the purpose of profit. However, the five traditional ways of cash out have been converted to a new way of "personal cash out" In recent years with the wide application of third-party payment and the reduction of card machines cost. Cardholders can purchase and install card machines to realize cash out by themselves. All card machines on the market can provide virtual order receiving merchants and virtual transaction merchants, making the personal cash out more convenient and reliable than those traditional cash out methods. Since banks have many difficulties in identifying cash out, it is of great significance to study and find out the identification method of personal cash out to reduce credit card risk.

## 3 Identification Method of Credit Card Cash Out

The characteristics of cash out are mainly that billing interest-free period of each transaction should be as long as possible and the used proportion of credit line is as high as possible. At same time, for avoiding system supervision, credit card line remains a small room not used in each billing cycle.

### 3.1 Multi-criterion correlation analysis and identification of cash out

For identification of cash out with those above five traditional methods, the attention should be payed to the abnormal transactions of merchants in the first method and to the abnormal transactions through Internet banking of cardholders in the second, and to that the location of swiping are the same in the third and fourth ways. Since the fifth method is to cash out by swiping card of other person, for identification of cash out, it needs to pay attention to the repayment for more than one person. The identification method is that calculating the average monthly transaction amount of each type

of merchant in certain area of a period and then carrying out the correlation analysis of transactions meeting some following criteria:

- (1) the transaction amount is more than twice the industry average;
- (2) The consumption amount of each transaction is more than 5000 Yuan;
- (3) Swiping more than five times at the same merchant;
- (4) Swiping amount are mostly an integer.

Through the correlation analysis, the suspected cash out will be screened out from the massive consumption records. This screening out is very useful for the research and judgment of real cash out in next step of identification, but these multi-criterion correlation identification method based on finding the POS merchant offering cash out service is invalid now. It is necessary to found out a new cash out identification method. An innovative method identifying cash out base on time series analysis is as follows.

### 3.2 Time series analysis and identification method

The credit line of a credit card is set as  $E$ , the minimum interest free period as  $d$  ( $d = 25$ ), the billing cycle days as  $N$  ( $N = 30$ ), and  $i$  ( $i = 1, 2, \dots, N$ ) is set for the  $i$ th day from a beginning of a cycle,  $j$  ( $j = 1, 2, 3, \dots$ ) for the  $j$ th billing cycle from a certain record date. The remaining available line amount at the end date of the  $(j-1)$ th billing cycle is set as  $E_j$ . In the  $j$ th billing cycle, from the day after the billing day, the each day total consumption amount  $x$  is recorded and the time series of the total consumption amount for the  $i$ th day is recorded as  $x_{ij}$  ( $i = 1, 2, \dots, N; j = 1, 2, 3, \dots$ ). Then the total accumulated consumption amount in the  $j$ th cycle is:  $T_j = \sum_{i=1}^N x_{ij}$  ( $j = 1, 2, 3, \dots$ ). Since the accumulated consumption amount  $T_j$  in the cycle is only relevant to the daily consumption amount and has nothing to do with the time of swiping, it does not reflect the characteristic of that cash out needs a long interest free period. Therefore, variable  $\mu$  which represents occupancy efficiency of bank funds is introduced as the observation variable of cash out. The utilization efficiency of bank funds by cardholders in the  $j$ th billing cycle is defined as:

$$\mu_j = \sum_{i=1}^N (N - i + d) X_{ij} / E_j (N + d) \tag{1}$$

In the Formula (1),  $N + d$  represents the longest days that funds can be occupied and  $N - i + d$  the actual days occupied. The following is an analysis of the utilization efficiency of bank funds with time series:

(1) If the time series  $x_{ij}$  is as follows:  $E_j, 0, 0, \dots, 0$ , which indicates the credit line is used up when cash out accure in the first day of the cycle, the bank funds are occupied the most efficiently and the funds occupancy efficiency reaches the maximum, then  $\mu_{max} = 100\%$ .

(2) If the time series  $x_{ij}$  is as follows:  $0, 0, \dots, E_j$ , which indicates the cash out accure at the end of the cycle, the funds occupancy efficiency reaches the minimum when the credit line is used up, then  $\mu_{min} = 45.5\%$ .

(3) If the time series  $x_{ij}$  is as follows:  $E_j/N, E_j/N, \dots, E_j/N$ , which means the cash out accure every day at the equivalent amount and the credit line is also used up, the

funds occupancy efficiency reaches the median value, then  $\mu_{jmed} = 72.7\%$ . Through this fund occupancy rate obvious cash out can be considered.

(4) If the time series  $x_{ij}$  is as follows:  $x_{ij} \approx 0$  ( $i = 1, 2, \dots, N$ ), which can be regarded as no occupation of bank funds, funds occupancy efficiency closes to zero, e.g.  $\mu_j \approx 0$ . It indicates that no cash out occur.

(5) If the time series  $x_{ij}$  is as follows:  $1/2 * E_j/N, 1/2 * E_j/N, \dots, 1/2 * E_j/N$ , the cash occupancy efficiency is the half of the  $\mu_{jmed}$ , e.g.  $\mu'_{jmed} = 1/2 * \mu_{jmed} = 36.35\%$ , which can be regarded as a highly concealed cash activity and used as an observation reference point of cash activity.

In practice, cardholders usually control the credit card accumulated consumption amount within the cycle less than 80%~95% of the remaining available limit  $E_j$ , e.g.  $T_j \leq (0.8 \sim 0.95)E_j$ , and the remaining available line  $E_j$  will be used in several different times to improve the cash out concealability, e.g.  $x_{ij} < (0.8 \sim 0.95) E_j$ . So all the efficiency of capital occupancy  $\mu_j$  is less than 100% and then it is necessary to set a threshold value  $\mu_y$  for the screening of cash out. If the card fund occupancy efficiency is higher than the threshold value  $\mu_y$ , which means  $\mu_j > \mu_y$ , it is preliminarily determined that the credit card is suspected of cash out. The threshold value  $\mu_y$  is determined by taking  $\mu'_{jmed}$  as the benchmark reference value  $\mu_b$  ( $\mu_b = \mu'_{jmed} = 36.35\%$ ) and introducing risk factor  $k$  to adjust the threshold, then  $\mu_y = k \mu_b$  ( $k = 0 \sim 2.75$ , generally,  $k = 1 \sim 2$ ). When the risk factor  $k$  increases, the cash out screening threshold  $\mu_y$  becomes higher and the detection of cash out is more accurate, but it is easy to miss the credit card with less obvious cash out. When  $k$  decreases,  $\mu_y$  becomes lower, the detection is more vague and then many non-cash out cards will be screened out. As the result, the workload of further research and judgment on suspected cash out cards increases, but those non-obvious cash out cards will not miss easily. So  $\mu_y$  needs to be adjusted dynamically according to the specific needs and practical experience.

## 4 Case Analysis Of Personal Cash Out

### 4.1 Real cash out card billing information analysis

The following is a case analysis of a real cardholder who cashed out frequently. On the premise of ensuring customer privacy, customer Z provided the cash out card billing information and assisted in finding out the transaction records those are really cash out. One of cardholder Z's credit cards with last four numbers 7841 is selected for analysis. The credit line of this card is 50,000 yuan. The billing date is the 18th of each month and last payment date the 12th of next month, so the maximum interest free period is 54 days. All consumption information from the 19th of last some month to the 18th of that month is recorded in that month bill. The consumption information after the 19th of that month is recorded in the next that month bill. Bills of credit card with ending numbers of 7841 obtained from the past 14 months are sorted out in the

Tab.1. Cardholder Z has confirmed that all records are cash out records and all consumptions are false consumptions in Tab.1.

**Table 1.** Analysis of credit card bill for card ending No. 7841

No.	swiping date	cycle $j$	day $i$	amount $x_{ij}$ (¥)	$\mu_i$ (%)	description
1	2022-6-19	1	1	11,572.00	78.1	Guangxi Pengchiao Automobile Sales Co. LTD
2	2022-6-24		6	7,255.00		Nanning Honghua Electrical Equipment Department
3	2022-6-27		9	6,422.00		Yege Restaurant, Yongning District, Nanning City
4	2022-7-20	2	2	14,552.00	79.6	Nanning Dashi Trading Co. LTD. Ningtie branch
5	2022-7-25		7	6,244.00		Nanning Ruijia Refrigeration Engineering Co. LTD
6	2022-8-22	3	4	17,085.00	78.4	Guangxi Nanning Luze Technology Co. LTD
7	2022-8-23		5	7,000.00		Guangxi Mingtu Automobile Sales Co. LTD
8	2022-9-22	4	4	17,932.00	78.0	Nanning Shaozhan Trading Co. LTD
9	2022-9-24		6	6,000.00		Nanning Ruizhivuan Jewelry Processing Shop
10	2022-10-20	5	2	3,100.00	80.6	Guangxi Zefeng Automobile Trading Co. LTD
11	2022-10-21		3	16,407.00		Nanning Baicao Imperial Health Care Center
12	2022-11-22	6	4	15,744.00	66.4	Nanning Yuejing Hotel Management Co. LTD
13	2022-11-30		12	4,000.00		Guangxi Hengziyuan Household Co. LTD
14	2022-12-12		24	10,500.00		Guangxi Jinchun Catering Management Co. LTD
15	2022-12-20	7	2	15,704.00	81.9	Nanning Janoen Automobile Service Co. LTD
16	2023-1-29	8	11	15,740.00	68.0	Nanning with You Restaurant Management Co. LTD
17	2023-2-21	9	3	15,884.00	77.2	Nanning Ruifa Stone Business Department
18	2023-2-25		7	16,472.50		Guangxi Apartment Hotel Management Co. LTD
19	2023-3-22	10	4	11,000.00	75.5	Guangxi Zhaolan Automobile Service Co. LTD
20	2023-3-29		11	4,822.00		Lovely baby Things Play jewelry store, Nanning City
21	2023-4-21	11	3	20,471.75	78.9	Guangxi Nanning Sapales Decoration Design Co. LTD
22	2023-4-24		6	10,000.00		Guangxi Chonghe Education Consulting Co... LTD
23	2023-5-22	12	4	10,000.00	73.7	Nanning High-tech Zone Zhenping Beauty Shop
24	2023-6-4		16	3,800.00		Nanning DeBen Auto Maintenance Service Co. LTD
25	2023-6-27	13	9	11,205.40	71.0	Nanning Ruiqiyang Education Consulting Co. LTD
26	2023-7-23	14	5	7,584.20	72.4	Nanning Zhou Bing Hardware Store
27	2023-7-25		7	17,425.70		Nanning Jiangxin District Mobile Phone Shop, Gaoxin
28	2023-8-1		13	8,000.00		Nanning Dazhong Mobile Phone Maintenance Dept.

**4.2 Analysis of multi-criterion correlation with traditional recognition methods**

The enterprise information query system provided on the Internet is used to query the information of merchants in the transaction information. All the names of merchants are checked and it is found that all the transaction merchants in the bill are real merchants that can be queried in the system and there are no duplicate merchants on checking. This fact shows that the credit card machine applies the technical means of storing real merchants in the machine. The credit card machine carries out random

virtual matching of local merchants in each transaction. The bill is presented with the real merchant name and the merchant name is generally used only one time. Therefore, the criterion of using the merchant information to identify the cash out has failed in practical use.

There are 28 cashing transaction records in Tab. 1, of which 8 records have integer card amount (whole hundred Yuan) and 18 records have non-integer card amount (non-whole hundred Yuan). The proportion of non-integer card amount records is 64.3%, which is much higher than that of integer card amount records. This data show that the cardholder himself can set the swiping amount because the cardholder operates the personal cash on his own card machine. Therefore, the criterion that the swiping amount is an integer to identify cash has no practical effect. Further statistics on the swiping amount recorded in the cash transaction in Tab. 1 show that there are 24 card-swiping records with the swiping amount above 5000 yuan, accounting for 85.7% of all card-swiping records. This data indicates that the swiping amount is often large, but the swiping amount of real daily life consumption is mostly small consumption. So the criterion of the swiping amount more than 5000 Yuan can still be used as an identification indicator for the screening of suspected cash out.

### 4.3 Analysis of time series recognition methods

According to the above time series identification method, the capital occupancy efficiency  $\mu_j$  ( $j = 1 \sim 14$ ) of each billing cycle are calculated and listed in Tab. 1. As can be seen from Tab. 1 in the 14 billing cycles, the  $\mu_j$  of each billing cycle is higher than  $\mu_y$  and this is valid when  $k = 1 \sim 2$ . Therefore, it can be concluded that there is a cash credit card problem in every billing cycle of this card and cardholder Z. confirms this conclusion.

The same analysis is also carried out on the other 15 credit cards bills of cardholder Z according to the above analysis method. The analysis results show that the fund utilization efficiency of the bill cycle of normal consumption card is less than  $\mu_y$ , e.g.  $\mu_j < \mu_y = k \mu_b$  (the risk factor  $k = 1$ ). and the fund utilization efficiency of billing cycle of cash swiping card is large than  $\mu_y$ , e.g.  $\mu_j > \mu_y = k \mu_b$  (risk coefficient  $k = 1$ ). The conclusion is also consistent with the cash out action confirmed by cardholder Z completely. It can be seen that the time series recognition method used in the other 15 sample credit cards of cardholder Z. also has a high accuracy of 100% in identifying credit card cash out.

Since it is extremely difficult to obtain credit card statements containing cash out information that is confirmed by cardholders, this method lacks more actual sample analysis confirmed with cash out currently. In the actual credit card supervision work, the time series identification method is adopted to screen the cash out in a large number of customers' credit card samples, which can help the regulatory authorities to screen out cash out suspected. The capital occupancy efficiency  $\mu_j$  can't be used as the only indicator to judge the cash out of credit cards. For further judgement of the suspected cash out it is also necessary to combine with other identification indicators and experience of setting risk coefficient  $k$  is also needs to accumulate.

#### 4.4 Case analysis of the consequences of individual cashing out

Since the card personal cash out is carried out only by the cardholder himself, the cash out scale and the social impact is small and the concealment is deep, which will mainly cause the bank fail to carry out the risk control.

Through the communication with customer Z, it is known that the cashed funds is mainly used in real estate investment to solve the problem of down payment funds shortage which is 40% of the house purchase for buying a certain property. Since the down payment problem of the property purchase is solved through the card cash out, the bank's mortgage loan issued on the property and the credit card cash for the down payment will fail to return back if customer Z has a debt crisis, and so there isn't the ability for the bank to resist this kind of risk.

Another case is customer L who has also implemented the credit card cash out. Through the communication with customer L, it is learned that his cash out funds were completely used for private small loans, which can obtain high interest rates when lending out. Customer L is a teacher with a monthly salary of 5,000 Yuan. He holds 11 credit cards with a total credit line of 646,000 Yuan. These credit cards are all used for cash mostly. As the small loan issued by customer L is an unsecured private credit loan, the capital chain broken after nearly two years of operation and all the loans released cannot return. So all the cash out credit card is unable to repay and all the credit cards are overdue for a long time. The total amount owed on the credit card bill reached 857,000 Yuan including interest, this problem results in bad debts of these banks' credit cards.

## 5 Conclusion

The method of time series analysis and identification is put forward in this paper, and the occupancy efficiency model of bank funds used to identify the cash out. The case analysis shows that this identification method has a more accurate screening effect, and the consequences of individual cash out has been analyzed for giving support to the identification method. The screening of individual cash out has great application value that is helpful to strengthen credit card supervision and prevent credit card risks.

## Reference

1. Jiang S. Credit card cash detection and scoring model based on logistic [J]. *Computer Applications*.2019.29 (11):3088-3091+3095.
2. Zhou Yang. Application of data mining technology in detecting credit card cash out [J]. *Enterprise Review*.2019 (05): 189-190. DOI: 10.19354/j.cnki.42-1616/f.2019.05.113.
3. Jiang Xingbin. Research on Risk management of credit card business in Guangxi Branch of Bank of A [D]. Guangxi University.2018.
4. Zhao Jing. Cause analysis and measure suggestions for credit card cash-out behavior [J]. *Hebei Finance*, 2021 (10):33-36. DOI: 10.14049/j.cnki.hbjr.2021.10.010.

5. Wickramasinghe, V. and Gurugamage, A. Effects of social demographic attributes, knowledge about credit cards and perceived lifestyle outcomes on credit card usage [J].International Journal of Consumer Studies 36 (1) Jan 2012, pp.80-89.
6. LeeCheonWoo and Woo-Hyung, Hong. The role of the tax incentive system of credit card in south korea 2019. The Credit Card Review 13 (1), pp.19-37.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

