Valuation of a Bank Credit-Card Portfolio

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ABSTRACT

This paper presents a simple model of the valuation of a portfolio of a credit cards held by a bank. Using discounted cash-flow analysis, the model takes into account various factors that may influence the value of the portfolio. These factors include the balance on the cards, fees and penalties, interest rate, and default rate of the cardholders. The model is then tested using actual data.

1. INTRODUCTION

First issued in 1950, Diners Club Card was the forerunner of the modern credit card. It carried the names of 28 New York restaurants where customers could charge food and drink, and get a bill for them at the end of the month. Credit cards have now become a permanent fixture on the national scene. At the end of 2004, Americans carried 657 million bank credit cards (4).

Some of the largest banks have millions of cards in the hands of cardholders. With 88 million credit cards, JPMorgan Chase is the nation's largest issuer, with $134.7 billion of outstanding loans (15). Some of the other large portfolios belong to Citigroup ($115 billion) and MBNA ($83.5 billion) (9). In 2005, Bank of America acquired MBNA.

There is fierce competition among card issuers. After saturating the adult population, the banks are offering credit cards to students and young adults. To gain customers, most of the card issuers have dropped the annual fees, and they are offering promotional rates as low as 0% for the first six months. The card issuers sent 1.285 billion direct mail solicitations in the first three months of 2004, an average of 5.3 solicitations per household per month. The response rate was 0.4% (10).

There is also consolidation in credit-card industry. Many of the smaller regional banks are moving out of this business, selling their credit-card portfolios to national banks. An investment-banking firm, R. K. Hammer, negotiated 75 portfolio sales in 2004, with a total value of $30.57 billion (14).

A paper by Trench, et al. (2) provides an excellent survey of actual management of a credit card operation. They designed the portfolio control and optimization system using Markov decision processes to select interest rate and credit lines for each card holder that maximize the net present value for the portfolio. They identify the main sources of income, interest, merchant fees, and various other fees. Offering a higher credit limit, coupled with lower interest rates, induces customers to charge more on their credit cards. However, a higher credit limit also increases the default risk and a lower interest rate reduces the income for the bank.

Chakravorti and Shah (1) analyze the relationship between cardholders, merchants, banks, and card networks. They observe the lack of competition between the networks in allowing the members banks from issuing rival credit cards. The article describes the nature of merchant fees and their impact on the selling prices.

2. THE BASIC MODEL

R. K. Hammer (14), an investment-banking firm active in the negotiated sales of credit-card portfolios, lists several factors that they consider in the valuation of these portfolios. These include: (1) Credit Quality, as evidenced by original credit criteria, credit bureau risk scores, behavior scores, bankruptcy scores, and the trends of those score patterns; (2) Attrition Rate, the percentage of accounts and balances (and the profitability of those accounts), that close voluntarily (customer requested closure) vs. involuntary (bank revoked); (3) Income Yields, the APR, annual fee structure, nuisance fee structure, teaser rates outstanding, the percentage revolving; and (4) Open vs. Closed, the percentage of accounts and balances, that are open to buy vs. those that are closed (but who also may be paying as agreed and, therefore, not delinquent). Their methodology is proprietary.

This paper presents a simple valuation model based on discounted cash flow analysis. The model analyzes the impact of various factors on the premium that a buyer should pay over the receivables of the credit card accounts.

2.1 Fees

In this section, we develop a simple model for the valuation of a credit-card portfolio. We may estimate the value of a portfolio and thus, the value of a single card to the issuer. Suppose a bank has issued N cards in all. The bank charges several different fees on the credit card customers. These fees could be annual fees, over the limit fees, late fees, foreign currency transaction fees, cash advance or convenience check fees, and others. Dividing the total fees collected by the total number of cards outstanding, we may find the current average fee F charged across *all* cardholders. The average fees F collected on a credit card are strongly correlated to the revolving credit balance C on the account. As a first approximation, we may set

$$F = \alpha + \beta C$$

Assume that α and β are constants, but the revolving balance per card shows a long-term growth rate of g_C. Assume that the cost of capital to the bank is r. To simplify the problem mathematically, assume that this income will continue forever. The value of this perpetuity is

Total fees
$$V_1 = \sum_{i=1}^{\infty} \frac{N[\alpha + \beta C(1 + g_C)^{i-1}]}{(1 + r)^i} = \frac{N\alpha}{r} + \frac{N\beta C}{r - g_C} \tag{1}$$

2.2 Transactors

We may classify the cardholders as those who pay their entire balance within the grace period (transactors), and those who continually carry a balance on their accounts (revolvers).

Consider the transactors first. Their monthly charges are just equal to their monthly payments. They pay the bills within the grace period without paying any interest. Such customers use the bank's capital for their personal purchases, thereby creating a loss for the bank. Suppose the average balance on these accounts at the end of each month is B, averaged over the total cards N. Let G be the grace period defined as the weighted average of the number of days between purchase of an object and its eventual payment, the weights being proportional to the price of the item. The amount of this monthly loss per card is thus

$$-B + \frac{B}{(1 + r)^{G/365}} = -B[1 - (1 + r)^{-G/365}]$$

Let us assume that the annual loss is 12 times as much, and the annual rate of growth of this activity is g_B. We may find the value of this perpetuity for all N cards as

$$-\sum_{i=1}^{\infty} \frac{12NB[1 - (1 + r)^{-G/365}](1 + g_B)^{i-1}}{(1 + r)^i} = -\frac{12NB[1 - (1 + r)^{-G/365}]}{r - g_B}$$

If these cardholders buy their merchandise uniformly throughout a month, the bank makes an average investment = $NB/2$ in such customers.

Transactors
$$V_2 = -NB/2 - \frac{12NB[1 - (1 + r)^{-G/365}]}{r - g_B} \tag{2}$$

2.3 Revolvers

Next, let us consider those cardholders who carry a certain balance on their cards every month. Due to the revolving balance that they carry, they are known by their picturesque name, revolvers. The outstanding balance on a given card may fluctuate, but the total balance for all the cardholders remains essentially stable, but shows an upward trend.

Let us consider the total revolving balance for the credit cards, and divide it by the total number of cards issued by the bank. This will give us the average balance per card, C. The annual rate of interest charged by the bank on the revolving balance on an account is R. Let us assume that the rate of growth in this amount is g_C. This will create another perpetual income stream whose present value is given by

$$-NC + \frac{NC(1 + R/12)}{1 + r/12} - \frac{NC(1 + g_C/12)}{1 + r/12} + \frac{NC(1 + g_C/12)(1 + R/12)}{(1 + r/12)^2} \ldots \infty$$

The sum of this series is

Revolvers
$$V_3 = \frac{NC(R - r)}{r - g_C} \tag{3}$$

These accounts create value for the bank because the interest charged by the bank R (perhaps 15%) is much higher than the cost of capital for the bank r (currently around 2.5%).

2.4 Operating expenses and Defaults

Let us consider the total annual expenses in maintaining a credit card operation, including printing and mailing of the bills and other administrative expenses. The operating expenses average out to be 4.9% of the assets invested in a credit-card portfolio (7). This ratio has remained constant over the last several years. If we represent the expense ratio as x, then these costs are xNC at the end of each year, and their present value as perpetuity is $V = -xNC/(r - g_C)$.

It is estimated that about 5.6% of the cardholders default on their loans (7). This represents a major cost to the issuer. The outstanding balance on the cards is NC. The annual loss on these cards is thus $-dNC$, where d is the percentage of assets lost due to default. The loss of value due to these cards is thus $-dNC/r$. If we include the growth factor g_C in the average revolving account balance C, then the total loss of value due to operating expenses and charge-offs is

Operating expenses and charge-offs,
$$V_4 = -\frac{(x + d)NC}{r - g_C} \tag{4}$$

2.5 Merchant Fees

Whenever a merchant sells something to a customer, who uses a credit card for the purchase, the merchant must also pay a percentage of the sale price to the acquirer bank. This is another important source of revenue for the issuer bank. There are generally five participants in a credit card transaction. Their relationship is as in Figure 1(1):
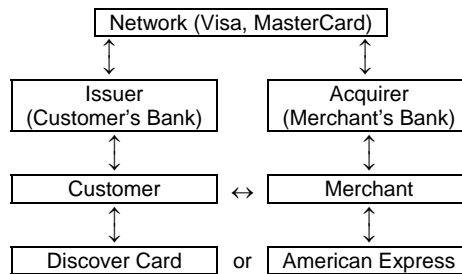

Figure 1: The banks that issue Visa and MasterCard belong to the network of banks. Discover and American Express issue their own cards, so they keep all the merchant fees. The arrows represent a relationship or a transaction.

The merchant pays roughly 2.5% of the sales price of an item to its bank, the acquirer. The acquirer bank, the issuer bank, the card association, and the customer share this revenue. In practice, the issuer bank collects roughly 1% of the total credit card sales.

Suppose the total monthly sales on a portfolio of N credit cards are NS. The merchants pay a percentage of this amount to the acquirer bank. Suppose the issuer bank receives a fraction a of the sales. The monthly income to the bank is thus aNS. This equals $12aNS$ per year. Let us assume that the sales per card are growing at an annual rate g_S. The value of this perpetuity to the issuer bank is

Merchant fees
$$V_5 = \frac{12aNS}{r - g_S}$$
(5)

In the above expression, S is the average monthly sale per card, averaged over the entire portfolio.

The total NPV of the credit-card portfolio is the sum of the five components of the value given by equations (1-5). Thus

$$NPV = \frac{N\alpha}{r} + \frac{N\beta C}{r - g_C} - NB/2 - \frac{12NB[1 - (1 + r)^{-G/365}]}{r - g_B} + \frac{NC(R - r)}{r - g_C} - \frac{(x + d)NC}{r - g_C} + \frac{12aNS}{r - g_S}$$

$$NPV = \frac{N\alpha}{r} - NB/2 - \frac{12NB[1 - (1 + r)^{-G/365}]}{r - g_B} + \frac{NC(R + \beta - r - x - d)}{r - g_C} + \frac{12aNS}{r - g_S}$$
(6)

If a bank wants to sell its portfolio to another bank, it must ask for the NPV, plus the amount payable to the bank by the cardholders at a given instant in time. Let us call the total outstanding balance on all credit cards to be A, which is the balance of the revolvers plus half that of the transactors. That is, $A = NB/2 + NC$

The selling price of the portfolio is thus

$$\text{Selling price} = NC + \frac{N\alpha}{r} - \frac{12NB[1 - (1 + r)^{-G/365}]}{r - g_B} + \frac{NC(R + \beta - r - x - d)}{r - g_C} + \frac{12aNS}{r - g_S}$$
(7)

In the above expression, we define the symbols as follows:

α = the constant part of fees
βC = the variable part of fees, proportional to revolving balance
a = percentage of the sales received as merchant fees
B = average monthly balance on a transactor card
C = average monthly revolving balance on interest-bearing cards
d = default rate, the percentage of the receivables not received
F = average annual fee charged per card
G = grace period in days
g_B = rate of growth of the transactor balances per year
g_C = rate of growth of the revolving balances per year
g_F = rate of growth of the credit-card fees per year
g_S = rate of growth in the charges, or sales, per year
N = total number of cards issued
r = annual cost of capital to the bank
R = annual rate of interest on the outstanding balance
S = average annual sales charged on each card
x = operating expense ratio

3. DEVELOPMENTS OF THE MODEL

3.1 Convenience Checks

Banks frequently send out special offers of reduced APR to the cardholders in the form of convenience checks. The purpose of a convenience check is to give an incentive to inactive cardholders to be active cardholders. A typical convenience check offers the customer a lower rate for a short period. This could be as low as 0% for the next six months, after which the rate would revert to the regular rate. Some cardholders will take advantage of this special offer just for the specified period and then pay the balance in full. This can create a loss for the bank. To overcome this loss, the bank may impose a special fee for using the convenience check. Suppose this fee is ϕ, the special rate is ρ, the corresponding period is τ months, and minimum monthly payment is π. The amount available on the convenience check is A and the cost of processing a check is γ. The NPV of this check to the bank is

$$\text{NPV} = -A - \gamma + \phi + \sum_{i=1}^{\tau} \frac{[A - (i-1)\pi]\rho/12}{(1 + r/12)^i} + \frac{A - \tau\pi}{(1 + r/12)^\tau}$$

If a cardholder uses a convenience check, and then carries the balance beyond the special period, he will create a profit for the bank. The monthly payments needed to pay off the remaining balance of the check is $(A - \tau\pi)/\pi$. Suppose this comes out to be approximately ν level payments. The NPV of this check to the bank is

$$\text{NPV} = -A - \gamma + \phi + \sum_{i=1}^{\tau} \frac{[A - (i-1)\pi]\rho/12}{(1 + r/12)^i} + \sum_{i=\tau+1}^{\tau+\nu} \frac{[A - (i-1)\pi]R/12}{(1 + r/12)^i}$$

A bank may send out many convenience checks every month, while the cardholders actually use only a small fraction of them. Suppose the cardholders use n checks per month with an average balance A. The probability that the balance on a convenience check will be stretched out to its fullest is p. Then the NPV of check-related bank operations for one month is

$$\text{NPV} = n\left(-A - \gamma + \phi + \sum_{i=1}^{\tau} \frac{[A - (i-1)\pi]\rho/12}{(1 + r/12)^i} + p\sum_{i=\tau+1}^{\tau+\nu} \frac{[A - (i-1)\pi]R/12}{(1 + r/12)^i}\right)$$

Although it is tempting to assume that the bank will be able to continue with this operation forever. In reality, it will saturate the market rather quickly. Further, to encourage cardholders to carry a balance for a longer period, the bank may offer a lower rate for the life of the loan. This action will change the cardholders into paying customers whose value is given by (3). We redefine n as the number of checks per month actually used by the customers in the steady state. The value created by these checks will be

$$V_6 = \frac{12n}{r}\left(-A - \gamma + \phi + \sum_{i=1}^{\tau} \frac{[A - (i-1)\pi]\rho/12}{(1 + r/12)^i} + p\sum_{i=\tau+1}^{\tau+\nu} \frac{[A - (i-1)\pi]R/12}{(1 + r/12)^i}\right)$$

3.2 Additional Fees

The card issuers impose additional fees, primarily late fees, average \$32.61 (6) and over-the-limit fees, average \$30.35 (5). This creates additional revenue for the bank and adds value to the portfolio. The side benefit of these fees is that the cardholders become prompt in paying their bills, thus reducing the default rate.

Many card issuers will allow their customers to pay their bills through ACH transactions. With proper authorization, the card user can pay either the minimum payment due, or the entire balance, on a given date every month. The money is automatically taken out of the cardholder's checking account and transferred electronically to the card issuer bank. This eliminates check writing and the possibility of a missed payment. From the point of view of the card issuer, it enhances the possibility of a steady income stream, but also reduces the amount of late fees. Although the cost of electronic transfer of funds is relatively small, some card issuers prefer not to allow the ACH payment of bills. They are obviously more interested in collecting late fees.

3.3 Incentives

GM Card takes 5% of the amount of monthly purchases and puts it in a special rebate account. The customer can take the balance of this account and apply it towards the purchase of a General Motors vehicle. For instance, if the amount charged for a whole year on a GM card is $10,000, the customer can buy a Chevrolet and get a rebate of $500.

Suppose a cardholder charges an amount S per month and he plans to buy a car after N months. Then value of this incentive to the cardholder is

$$\frac{.01NS}{(1 + r)^{N/12}}$$

If we look at the situation closely, the cardholder has an option that he may exercise at any time. The intrinsic value of this option, if exercised right away, is the value of the rebate account.

4. ESTIMATION OF PARAMETERS

We can estimate the values of the parameters used in this model by surveying some of the macroeconomic data available. For the entire nation, the revolving consumer credit stood at $801.4 billion in January 2005. At the end of 2004, Americans carried 657 million bank credit cards (4). The revolving balance per card is thus 801.4/.657 = $1219.79. This gives us $C = \$1219.79$.

The monthly payment rate is 18% of total balance (3), (13). The total outstanding balance is therefore 801.4/.82 = $977.3 billion. We can then find the balance per card to be 977.3/.657 = $1487.52. The amount of money paid off each month is thus .18*1487.52 = $267.75 per card. This gives an estimate of balance of a transactor, $B = \$267.75$. From the JPMorgan Chase data (15), we find the average loan per card is 134.7/.088 = $1530.68. This could be $1219.79 in revolving credit and 1530.68 − 1219.79 = $310.89 in transactor balance. This number is comparable to the national average.

Americans paid more than $24 billion in credit card fees last in 2004, an 18% jump over the previous year. The figure does not include balance transfer fees, foreign exchange fees, fees for ancillary services, or miscellaneous fees for account research, which could easily push the number above $30 billion (8). For 657 million cards, the average fee per card is 30,000/657 = $45.66. This gives us $F = \$45.66$. We now split it into a fixed part $\alpha = \$15$, and a variable amount $30.66. This gives us $\beta = 30.66/1219.79 = .02514$.

The income derived from the merchant fees is somewhat difficult to determine. It depends upon the type of card and the relationship of a merchant with its bank, the acquirer. Chakravorti and Shah give a good analysis of these relationships (1). However, to simplify this, we will assume that the amount of fees collected is approximately 1% of the sales. This means $a = .01$.

The estimate of operating expenses and default rate are available at the website www.carddata.com (7). The latest figures for 2004 are, operating expense ratio, $x = 4.9\%$ and the default rate 5.6%. The operating expense ratio has remained fairly steady, dropping from a high of 5.5% in 1989 to its lowest value 4.2% in 1995. It rose again to its current value of 4.9%. Its historical average for the years 1989-2004 is 4.7%. On the other hand, the default rate, d has climbed steadily from 3.8% in 1989 to 5.6% in 2004. The average default rate during this period has been 4.681%. It is quite possible that the default rate will reach a peak of 6%, and stay there. Thus we assume that $x = 4.9\%$ and $d = 6\%$.

The cost of funds employed in a credit-card operation is also provided in (7). The current value of r is 2.5%, which is the lowest for all the years for which data is available. The average for the years 1989-2004 is 5.69%. It is desirable to use the historical value $r = .0569$, rather than its current one.

We can find the growth rate of consumer debt from (3). The revolving credit grew from $758.7 billion to $801.4 billion in 13 months. The annual growth rate is thus $(801.4/758.7)^{12/13} − 1 = 5.184\%$. Thus g_C = rate of growth of the revolving balances per year = 5.184%. The available information covers only a year. For longer periods, the rate of growth is probably much less, perhaps around 3%. We also expect the transactor balances to rise

by about the same amount. Thus $g_C \approx g_B \approx 3\%$. The rate of growth of sales per card is also likely to be 3%, possibly higher. Nevertheless, we will assume that $g_S \approx 3\%$.

Since the bank controls the fees that it can impose on the cardholders, it will increase them steadily (5), (6). For the years 1994-2004, the rate of growth in late fees is 10.023%. Similarly, the rate of growth for over-limit fees is 9.06%. It is unlikely that the banks will be able to sustain these growths. After a period of explosive growth, the long-term growth rate will be somewhat less than the other growth rates, namely 2%. It is difficult to get hold of this number precisely, and we shall simply use $g_F = 2\%$.

Suppose a card issuer combines the sales in a given month at the end of the month. It takes the bank roughly five days to prepare and mail the statement. The customer probably gets the statement after another five days. The customer has to pay the bill in approximately twenty days to complete the monthly cycle. The customer will probably send the bill by mail in about ten days to avoid the late fees. If the bank gets the money on the 25th day of the next month for the sales in a given month, then the average delay in receiving the money for a given sale is 40 days. Therefore, we shall assume the average grace period on credit cards is 40 days. In this model, we shall assume $G = 40$ days.

According to R. K. Hammer (14), the total income on a credit-card portfolio is 17.5%. Excluding the merchant fees and other fees, the net amount is probably 12%. This is the interest charged by the bank. We may assume that $R = 12\%$. The website of TIAA-CREF (17) states that the cardholders paid more than $7 billion on a total revolving balance of $743 billion in September 2004. This gives us the overall interest rate to be 12*7/743 = 11.31%.

Let us assume the average monthly sales charged on a card are $400. As we have seen already, the transactor balance is $267.80, which equals the monthly purchases charged by him. We may assume that the revolver buys roughly $132 in merchandise every month. That is, $S = 400$.

Let us assume the following case of a hypothetical portfolio. There are 10,000 credit cards in it. The average balance on each card is $1487.52, with the revolving amount $1219.79 and the transactor amount $267.75. The total debt on the portfolio is $13.537 million. The default rate is 6%. The average annual fee charged on each card is $45.66, with $\alpha = 15$ and $\beta = .02514$. The grace period is 40 days. The income from the merchant fees is 1% of the sales on the card. The long-run default rate is 6% and the operating expenses are 4.9% of the value of the value of the portfolio. The average interest rate on the unpaid balances is 12%, whereas the cost of capital to the bank is 5.69%. For the growth rates, we use $g_C = g_B = g_S = 3\%$. Using these numbers, we obtain the following:

NPV of the portfolio	$2.504 million
NPV of each card	$250.37
Selling price of the portfolio	$16.040 million
NPV/Accounts receivable = p	18.50%

Thus the premium p that a buyer of this portfolio should pay over the accounts receivable is roughly 18.5%.

5. CONCLUSIONS

R. K. Hammer (16) reported that the size of the portfolio affected the size of the premium. The premiums for portfolios of under $1 million ranged from 5% to 10%. Portfolios of $1 million to $5 million got a premium of between 6% and 16%, while portfolios of $5 million to $10 million got 7% to 17%, and portfolios of $10 million to $20 million got between 10% and 27%. The result found in this paper is comparable to theirs.

We investigate the effect of various parameters on the value of the premium, p. We can do that by differentiating p with respect to a, g_S, R, g_B, g_C, d, x, and r. The numerical values of these derivatives are given below.

Derivative	Value
$\partial p/\partial a$	131.8
$\partial p/\partial g_S$	49.00
$\partial p/\partial R$	33.50
$\partial p/\partial g_B$	-19.83
$\partial p/\partial g_C$	-25.86
$\partial p/\partial d$	-33.50
$\partial p/\partial x$	-33.50
$\partial p/\partial r$	-49.33

The biggest impact on the premium is due to an increase in the merchant fees. If the merchant fees move up from 1% to 1.01%, the premium goes up from 18.50% to 19.81%. The second largest effect is that of rate of growth of sales, which is translated into higher merchant fees. The next is the impact of higher interest rates charged to the revolving balances.

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