

Business Model and Risk Management on Asset-based Financing

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Abstract: Although floating mortgage has been permitted in China, Asset based finance has not been carried out in practice. This article constructs an endogenous model of default probability for a single period, and optimizes the expected return rate of banks based on the borrower's operational risk and collateral risk. Research has found that for the contract dominated by bank, the determination of mortgage rate requires a comprehensive consideration of both borrower default probability and bank default losses, and an optimal mortgage rate is existed; Banks need to increase interest rates or reduce collateral ratios to cope with the increased risk of collateral.

1. Introduction

Asset-based Financing(ABF), in which borrowers borrow from banks on a collection of all their assets, including accounts receivable, inventory, machinery and equipment, trademarks and patents. ABF not only reduces the loan management costs that banks incurred to record frequent changes in the form of enterprise assets, but also allows borrowers to fully utilize the collateral under operating. In order to solve the problem of financing difficulties for small and medium-sized enterprises(SME), China has successively relaxed the prohibitions to promote the development of such businesses. However, due to the lack of sufficient risk management techniques by banks, they have been constantly impeded in practice. This essay aims to perform a prospective research on risk management in ABF, which can provide new and effective financing tools to solve SME financing difficulties.

Previous literature has mostly adopted the MM theorem approach, which have separated corporate financing from enterprise operations. Buzacott and Zhang (2004) first introduced the financing issues in the operational process. By constructing an inventory management model for ABF, it examined the impact of retailer ordering decisions and financial decisions, as well as bank interest rates affected by demand uncertainty and self-owned capital^[1]. Dada and HU (2008) constructed a supply chain financing model and found that loan contract made by banks can improve the efficiency of whole supply chain^[2].

Wu Yingjing and Li Yongjian (2015) measured the degree of core enterprises' financial risk sharing by using the repurchase rate to remaining collateral in case of default for inventory pledge

loan^[3]. Yan Nina and Sun Baowen (2014) conducted a research on the optimal ordering decision, wholesale price, and the interest rate of bank loan, for retailers with financial constraint by means of warehouse receipt pledge loan, and tested the wholesale price coordination effect of the supply chain finance^[4].

Wang Zongrun et al. (2015) analyzed the impact of implicit equity on the profits of financing enterprise, core enterprise, and bank by means of accounts receivable financing, and concluded that their financing costs are relatively low^[5]. Chen Xiangfeng et al. (2023) focused on the impact of the competition among retailers, suppliers and financially constrained institutions in the capital market on optimal decision-making^[6].

2. Analysis of Business Models in Asset-based Financing

ABF is a new financing model developed from inventory and accounts receivable financing. In the process of production and operation, from purchasing raw materials, manufacturing products, to selling and recovering payments, a large amount of working capital is required, and loans are needed to make up for the funding gap. Initially, enterprises often satisfied their operational capital demand through inventory financing or accounts receivable financing. However, in continuous production process, there are continuous changes in the form of inventory (raw materials to semi-finished products to finished products) and in the conversion of inventory to account receivables. The process of continuous changing of the type of collateral is too complex, and at the same time, banks have lower control ability on loan risks. Whereas to asset based financing, a collection of enterprise assets as collateral not only reduces loan transaction costs for both banks and enterprises, but also facilitates bank risk management. On asset based financing, once the borrower defaults, the creditor will take over all of the crystallization corporate assets of the borrowing company as compensation.

When the borrower has insufficient cash flow and is short of real estate collateral to obtain loans from other channels, they will apply for ABF. In ABF mode, the borrower can grant a loan from banks with all assets served as collateral, including accounts receivable, inventory, machinery and equipment, factory buildings, intangible assets etc. The bank sets different mortgage rates for different assets collateral. Machine equipment and intangible assets often have strong specificity, and their value depends on the continuous operation of the enterprise. The default realization value is not high, and banks set lower mortgage rates. The ability to realize inventory and accounts receivable is strong, and the bank sets higher mortgage rates. Inventory is divided into three types: raw materials, work in progress, and finished products. The product in process is an unfinished product with weak cashability, and a lower mortgage rate is set. Accounts receivable are inventory that has already been sold, with a lower default risk than inventory, thus grant for a higher collateral ratio set by the bank than inventory.

3. Model analysis Asset-based financing

3.1. Model Description

Simplify and construct a single period model based on the characteristics of ABF business in practice(Shown as table 1). At the beginning of the period, the borrower applied for an ABF loan with all its assets as collateral, loan amount is $L = \omega C$. At the end of the term, the borrower shall repay the principal and interest in the sum of $\omega C(1+r)$. Borrower's revenue R , is a continuous-type random variable with the distribution function $F(x)$ and the probability density function $f(x)$. Assuming that the probability of default is endogenous, as long as the borrower's present assets value is lower than the principal plus interest of the loan, the borrower will default

which can be expressed as $C + \omega C + R \leq \omega C(1 + r)$, so $\rho = \int_{-\infty}^{C(\omega r - 1)} f(x)dx$, $0 < \rho < 1$ Further assume that borrower's revenue risk is not related with financing behavior, that means R is independent from r and ω .

Table 1: A brief description of the borrower's assets and liabilities in the model

Assets	Liabilities and ownership
Initial assets C	Self-owned Capital C
Borrowed fund ωC	Loan principal plus interest $\omega C(1 + r)$
Revenue R	

Symbolic description:

C: borrower's initial assets value	R: borrower's revenue
L: principals of the bank's loan to the borrower	r: loan interest rate
t: bank's average return on condition of borrower's default	ρ : borrower's default probability
ω : bank's mortgage rate to borrower's assets (loan to value)	
λ : bank's recovery ratio by selling borrower's assets on condition of default, that is mortgage assets liquidity risk	

3.2. Regardless of liquidity risk of collateral assets

Bank's expect return:

$$\pi_L = \omega C(1 + r) + C(1 - \omega r)\rho + \int_{-(1+\omega)C}^{C(\omega r - 1)} xf(x)dx \tag{1}$$

As banks make loans to different borrowers at the same time, banks pay more attention to return rate than the overall return based on the loan size. The bank's expected return rate:

$$r_L = r(1 - \rho) + \frac{\rho}{\omega} + \frac{1}{\omega C} \int_{-(1+\omega)C}^{C(\omega r - 1)} xf(x)dx \tag{2}$$

Proposition 1: Regardless of liquidity risk of mortgage assets, the bank's expected return rate increases monotonically with the rise of loan interest rate. Increasing mortgage rate has a two-way effect: reduce bank's expected return rate by increasing borrower's default probability, whereas improve bank's expected return rate by decreasing the borrower's loss given default (LGD). There is an optimal mortgage rate which can maximize bank's expected return rate.

Proof: denote $t = \int_{-(1+\omega)C}^{C(\omega r - 1)} xf(x)dx$ to represent bank's average return on condition of borrower's default. For f(x) is a unimodal symmetric function, $\frac{d\rho}{dr} > 0, \frac{dt}{dr} > 0$ can be proved. equation (2) can be deduced to

$$\frac{\partial r_L}{\partial r} = (1 - \rho) + \left(\frac{1}{\omega} + r\right) \frac{d\rho}{dr} + \frac{1}{\omega C} \frac{dt}{dr} > 0 \tag{3}$$

$$\frac{\partial r_L}{\partial \omega} = -\frac{1}{\omega^2} \left[\rho + \frac{t}{C} - \omega \left(\frac{d\rho}{d\omega} - \frac{1}{C} \frac{dt}{d\omega} \right) \right] \tag{4}$$

According to formula(3) $\frac{\partial r_L}{\partial r} > 0$, we can conclude that bank's expected return rate increases monotonically with the interest rate of loan.

For the unimodal symmetric function f(x), $\frac{d\rho}{d\omega} > 0, \frac{dt}{d\omega} < 0$ can be proved, which means the increase of mortgage rate will induce default probability increasing and bank's return rate

decreasing. Moreover, loss given default $LGD = \frac{1}{\omega} \left(1 + \frac{t}{C}\right)$, it can be found that LGD decreases with the decreasing of t . An in-depth analysis of equation (4) reveals that

If $-(1 + \omega) \leq \frac{t}{C} < \omega \left(\frac{d\rho}{d\omega} - \frac{1}{C} \frac{dt}{d\omega}\right) - \rho$, $\frac{\partial r_L}{\partial \omega} > 0$, r_L increases monotonically with mortgage rate;

If $\omega \left(\frac{d\rho}{d\omega} - \frac{1}{C} \frac{dt}{d\omega}\right) - \rho < \frac{t}{C} < \omega r - 1$, $\frac{\partial r_L}{\partial \omega} < 0$, r_L decreases monotonically with mortgage rate;

So when $\frac{t}{C} = \omega \left(\frac{d\rho}{d\omega} - \frac{1}{C} \frac{dt}{d\omega}\right) - \rho$, $\frac{\partial r_L}{\partial \omega} = 0$, r_L reaches the maximum value.

Assume the optimal mortgage rate be ω^* , then

$$\omega^* = \frac{t + \rho C}{\frac{d\rho}{d\omega} C - \frac{dt}{d\omega}} \quad (5)$$

End proof.

According to the result of Proposition 1, bank can maximize the expected return rate by setting mortgage rate of ABF loan equal to ω^* . At the same time, raising the interest rate r can further increase the expected return rate. But in fact, the rising space of the bank interest rate r is very limited, which is not only constrained by the market competition, but also need to consider the adverse selection and moral hazard of loans.

3.3. Consider the liquidity risk of collateral assets

When $0 < \lambda < 1$

In case of borrower's default, the bank can sell out the borrower's assets to achieve self relief. However, due to the liquidity risk of the borrower's assets, the bank can only sell at a discount and recover $(1 - \lambda)$ proportion of the value of the assets. Bank's expected return can be rewritten as follows

$$\pi_L = \omega C(1 + r)(1 - \rho) + (1 - \lambda) \left[\rho(1 + \omega)C + \int_{-(1+\omega)C}^{C(\omega r - 1)} x f(x) dx \right] \quad (6)$$

The bank's expected return rate

$$r_L = r(1 - \rho) + \frac{\rho}{\omega} [1 - \lambda(1 + \omega)] + \frac{1 - \lambda}{\omega C} \int_{-(1+\omega)C}^{C(\omega r - 1)} x f(x) dx \quad (7)$$

Proposition 2: Considering the liquidity risk of collateral assets, the bank's expected return rate decreases with the rise of liquidity risk of collateral assets.

Proof: for Proposition 2 to be valid, $\frac{\partial r_L}{\partial \lambda} > 0$ need to be demonstrated.

From equation (7), we can find $\frac{\partial r_L}{\partial \lambda} = -\frac{\rho}{\omega} (1 + \omega) - \frac{t}{\omega C}$, as $t < 0$, and $-\frac{t}{\omega C} > \frac{1 - \omega r}{\omega}$.

For the value of ρ is tiny in practice, thus $1 - \omega r > \rho(1 + \omega)$ can be satisfied. As $-\frac{t}{\omega C} > \frac{\rho(1 + \omega)}{\omega}$, therefore $\frac{\partial r_L}{\partial \lambda} > 0$. End proof.

Proposition 3: If borrower's liquidity risk of collateral assets increases, the bank needs to raise interest rate or reduce the mortgage rate so as to satisfy the bank's expected return rate target.

Proof: The increasing liquidity risk of the borrower's assets does not affect the borrower's default probability ρ and bank's average return on condition of borrower's default t . Make r_L to be constant, partial derive equation (7) to r and ω , respectively

$$\text{As } t > -(1 + \omega)C, \frac{\partial r}{\partial \lambda} = \frac{(1 + \omega)C + t}{(1 - \rho)\omega C} > 0,$$

Meanwhile $t < -\rho C(1 + \omega)$, so $\frac{\partial \omega}{\partial \lambda} = \frac{\omega}{1-\lambda} \left(1 + \frac{\rho \omega C}{\rho C + t}\right) < 0$. End proof.

4. Risk management on asset-based financing

The key points of bank's risk management is to identify and prevent borrower's credit risk. Only in case of borrower's default can the bank exercise its right to sell out the collateral for self relief. Bank needs to closely monitor borrower's accounts and balance sheets in order to accurately identify and prevent borrower's operational risks.

4.1. Risk identification

Firstly, ABF lenders should conduct a thorough analysis on the borrower's repayment ability, with a focus on the cash flow obtained by the borrower from accounts receivable and inventory. At the same time, attention should be paid to the borrower's ability to realize collateral under lockdown, rather than information on income and balance sheets.

Secondly, as the quality of ABF loans largely depends on collateral, lenders should conduct a comprehensive analysis on the collateral. The determination of loan to value requires a comprehensive analysis on borrower's business, industry, industry position, and customer types.

4.2. Periodical risk control

At the early stage of credit, evaluate borrowers from four aspects: financial condition, operating cycle, industry, and management ability. At the same time, it is necessary to consider the quality, feature and recyclability of various forms of collateral in order to determine loan to value. Banks can compare loan to value of a certain loan in the same industry, or loan to value of borrowers in the most recent period to evaluate their suitability.

At the middle and late stages of credit, strict tracking should be carried out on contract terms, inventory, accounts receivable, etc. Abnormal behavior also need to be investigated. Establishing an effective regulatory information system between banks and borrowers is most important to ensure that banks obtain real-time information on asset categories and value changes of borrowers. The occurrence of over-stocked, obsolete, devaluation and liquidity risks of collateral should also be emphasized on.

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