



# Selecting an optimal portfolio of consumer loans by applying the state preference approach

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## Abstract

Internal models like CreditMetrics and KMV, implemented by banks to manage credit risk and assess regulatory capital, are significant examples of how practitioners apply modern portfolio theory (MPT) to the management of bank loan-portfolios.

From a theoretical perspective there are several reasons suggesting to be careful in extending MPT to the case of bank loan-portfolios selection in order to avoid misleading results. Specifically, loans' log-returns are non-normally distributed random variables, furthermore, decision-makers not necessarily perform a quadratic utility function. Because both of those reasons the traditional mean–variance approach is inadequate in building up optimal loan-portfolios. Such a conclusion is even more relevant if specific categories of loans are considered.

In our paper we deal with the problem of selecting optimal portfolios of consumer-loans by developing a state preference model. It allows us not to explicitly consider the distributional properties of loans' log-returns. The model is a static one having the objective to select the loan-portfolio maximizing the expected utility of wealth allocated by the bank managers, subject to a number of constraints accounting for fundamental strategic choices implemented by the bank managers.

Our results show that flexibility is the main characteristic of our model. In fact, adding constraints gives new optimal portfolios without reducing the expected utility of the decision maker. We will explain that such a result does not depend on constraints' misspecification but on the risk structure implied in the state preference approach.

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## 1. Introduction

How banks must group loans in order to create an efficient loan portfolio optimizing some sort of predefined objective function is an extensively de-

bated topic. The theoretical literature develops this problem following two alternative routes.

Mason (1978) starts from the assumption that the bank managers' objective consists of maximizing the value of the bank capital. They behave as if packages of credits could be transformed into high leveraged securities traded among bank shareholders. It follows that creating highly diversified loan portfolios containing credits characterized by

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low correlations does not necessarily translate into a benefit for bank shareholders. They can realize, in fact, any possible risk–return pattern on their own portfolios where the bank shares of stock are combined with other kinds of assets. What is more important is that bank managers select those credits producing comparative advantages in terms of costs or risks.

According to an alternative approach (see Hart and Jaffee, 1974) the aim of bank managers to preserve their position within the bank and the interest of regulators in preserving the safety and soundness of the banking system as a whole, justify a specific attention to diversification of loan portfolios as a tool to attain the stability of the bank itself.

Models like CreditMetrics and KMV, together with the last Basle accord on the regulation of bank capital, are strong signals of how the last approach is now the most popular among banks and regulators involved in managing and controlling loan portfolios.

The aforementioned models, aimed to measure the bank exposure to credit risk, are serious efforts to extend and adapt the principles of modern portfolio theory (MPT) (i.e. Markowitz, 1952, 1959; Sharpe, 1970) to the selection of bank loan portfolios. We share with other authors (see Saunders, 1999) the opinion that MPT could lead to misleading results when applied to loan portfolios. The main reason is that MPT is based on the assumption of normality referred to the log-returns of assets, which is not the case of bank loans.

Furthermore, loans are segmented in many different categories (e.g. consumer, corporate, real estate, syndicated loans, etc.) distinguished by completely different features like maturity, currency, repayment method, pricing technique, distributional properties of prices or returns. Selecting a portfolio of bank loans diversified across loan classes according to a unique and comprehensive theoretical model seems to be inappropriate.

What we suggest is to develop models allowing the bank to select the optimal mix of loans belonging to the same class. Obviously the selection model could change according to the specific features of the class considered. Once the bank has a set of optimal “sub-portfolios” of loans it faces

the problem of combining them in the optimal way. Such a two-stages approach to the selection of bank loan portfolios allows the decision maker to better account for the structural characteristics of different loans (i.e. probability distribution of returns, pricing, etc.), substantially improving the mathematical tractability of the problem.

The purpose of this paper is to focus on the first of the two aforementioned stages. The analysis will be referred to a portfolio of consumer loans built up by solving a static optimization model whose input variables are computed applying the state preference theory. Our choice to make use of such a theory in selecting the optimal bank portfolio of consumer loans indicates a new direction in banking theory and has the advantage to be easily extendible to any kind of probability distribution of loans’ returns or prices.

Our attempt of applying the state preference theory to the case of consumer loans represents a first step forward in designing portfolio selection models based on the structural features of the specific class of loans under consideration. In our paper we have a model where assets are priced on a pure discount basis as it is the case of consumer loans. Moreover, the pricing procedure is consistent with the risk-neutral principle employing the uniquely determined equivalent martingale measure as the probability measure associated to alternative states of nature.

The rest of the paper is organized as follows. In Section 2 we consider the theoretical and practical problems met in applying MPT to the case of bank loan portfolios. Particular attention is devoted to the distributional properties of bank loans. Section 3 explains in details the reasons why we decided to consider consumer loans. Section 4 presents the basic scheme of state preference theory and extends it to the case of consumer loan portfolios. In Section 5 the optimization model is developed and the main numerical results are discussed. Conclusions follow.

## **2. Limits of MPT in dealing with bank loan portfolios**

Bank loans are financial assets structurally more similar to fixed income securities (bonds)

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