International Journal of Economic Research

ISSN : 0972-9380

available at http: www.serialsjournal.com

Volume 14 • Number 3 • 2017

Optimization ofVarious Bank Loans Based on Capital Asset Pricing Model (CAPM) (Case Study of Bank Melli)

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Abstract: Banking system operation is classified into two main groups of resource collection and use of funds, has a direct correlation with banking interest. On the other hand, most banking uses are related to payment of different kinds of loans. Therefore, in this research, to optimize various bank loan portfolios the capital asset pricing model **(**CAPM) of investment has been used in Melli Bank of Iran. To this end, various loans provided by the bank were classified in 10 groups and it was tried, using CAPM model, to find the optimum combination of various loans. The obtained results of the fund portfolio calculation revealed that if the expected return and higher risk is considered, the allocated value is moved toward civil participation loans, leasing, hire purchase, and bailment of a capital.

Keywords: Capital asset pricing model **(**CAPM), portfolio management, banking loans, monetary market

JELClassification: G2, E5,C3

INTRODUCTION

Financial assets including investment assets that are interchanged in the investment market and among which the most known are the stocks. The investors in the resource investments in purchasing and holding stocks aim at the expected returns in a way that in the estimations of expected return, there is the possibility of deviation that in the financial literature is called risk. The results of the market model shows that the risk and the returns' effective factors are categorized into two groups of factors related to the company (unsystematic risk) and factors related to the market (systematic risks) that are remained with the formation

of the unsystematic risk portfolio and the omission of the systematic risk, Trinoy and Sharp and Linter introduced CAPM Model in the efficient marketing in order to reach the balanced pricing for the security bond (Amir Hoseini and Khosroyany, 2009)

Based on this model, the investors usually have different viewpoints toward the future; therefore, the estimation of the expected returns and the investment uncertainties and risks are different. Capital asset pricing model **(**CAPM) of investment states a simple relation between expected return and the risk of investment in competitive markets (Rafiqul Alam et al., 2015). Using this model, the investor can obtain capital market line through exact valuation of all his possible assets and by contactingthis line and efficiency frontier curve, the optimal combination is obtained (Jafari Samimi & Dehqani, 2007).

Capital asset pricing model known as CAPM is the central model in the modern financial economy. This model provides an exact and precise prediction about the relation between the expected return and risk of each asset (DeMiguel & Uppal, 2005). This relation fulfills two critical tasks:

1. Providing index return rate to evaluate existing investments
2. A scholarly guess on expected return

In the present research, first, it is suitable to explain the general model to explicate the problem and as it follows the way of applying the model is discussed. Then, with respect to some scenarios, the optimal combination of loans granted by Melli Bank is investigated. In this regard, the most important loans provided by Melli Bank during the years 2011-15 including 10 groups of loans are to be examined (Legal participation loans, Mosaqat (harvesting) loans, Civil participation loans, Interest free loans and depository, Contract of farm letting loans, Forward Purchasing loans, Leasing loans, Hire purchase loans, Contract of reward loans and Bailment of a capital loans)

REVIEW OF RELATED LITERATURE

Theoretical Foundation and Background Research

These applied asset models have been practically examined about half a century. The most known applied asset's model is the strategy of mean-variance (the theory of modern portfolio) that for the first time was developed by Markowitz (1952) to fulfill the process of optimization of the investment presupposing the combination of the fixed investment opportunity between different assets' groups in a period of time. Allocating the capital between some existing assets, in order to maximize the capital returns is done, when the specific indicator of the risk investment (that is usually quantified by the portfolio variance) is considered as fixed on the acceptable level of investor. Markowitz's work led to an understanding of the importance of the relationship between the assets' groups and the existing security bond in the portfolio. Markowitz in the articleentitled "The Selection of Portfolio" developed the first mathematical model of reducing fluctuation resulting of the portfolio formation. The theory of modern portfolio added a third dimension to the portfolio management that examines the effects of diversification of the investment on the portfolio. Therefore, the theory of modern portfolio transferred the inventor's focus on the single security bond to considering the entire portfolio. The optimal diversification is derived from a simple idea saying that many portfolios are used to carry your eggs (Gibson, 2008)

In the mid 1950s, James Tobin (1958) developed the Markowitz's work by adding the asset without risk to the analyses. Tobjn's work only focused on keeping two types of assets, i.e. the risky assets and the

assets without risk, that the assumption of giving and taking loans were also considered in order through which to provide a wider range of investment preferences and returns by utilizing these means (Schneeweis et al., 2010)

In the early 1960s in the independent researches of Jack Turner (1961 & 1962), William Sharp (1964), John Lintner (1965 A ,B) and John Mosin (1966), led to the development of the capital assets pricing model (CAPM) based on the early research of Markowitz in the diversification field and the modern portfolio theory. Sharp presented the theoretical relationship between the expected return and risk based on the combination of the individual behavior assumptions and the market condition. These writers showed that if the investors invest on the market mean-variance efficient portfolio, then the return ratio expected of the single security bond would directly relate to the role of the security bond paper on the market mean-variance portfolio. Under such circumstances, all the investors of the risky assets are kept with equal ratios. Thus, to access to a desired balance of the return and risk, the investors simply change a fraction of their portfolios that composed of the assets without risks (Canner et al., 1998)

Merton, in 1971, developed the CAMP theory in a continuous-time structure, along with a combination of the fixed investment opportunities, independent of time or even arbitrary considering directly the investment horizon, in an optimal process of development (Lenoir and Tuchschmid, 2001), Faka and Macbeth (1973) Brinson, Hood and Byiever (1986), Brinson, sayner and Byiever (1991) in their early studies surveyed the important and key role of the allocating the assets on the performance return of the samples of the retiring funds and stated that allocation of the assets is one of the most important decisions that affect the portfolio performance. Sharp in 1987 presentedan integrated approach of asset allocation that both considers the market condition and the objectives of the investor's asset. Even though it is possible that there are some similarities and common aspects between integrated approaches of allocation, the standard and predefined process for its establishment and practice does not exist. (Sedzro et al., 2012)

Brinson, Hood and Byiever (1986), Brinson, sayner and Byiever (1991) in their early studies surveyed the important and key role of the allocating the assets on the performance return of a sample of the retiring funds and stated that allocating the assets is one of the most important decisions that affect on the portfolio performance. They divided the general returns into three parts; A) The policy of allocating the asset: usually including the determining the inactive weight or natural investment group. B) Evaluation of the market condition: the management process of the weight of asset groups considering the passive assets in short periods of time. D) Choosing the bill of exchange: referring to the decisions on how the portfolio of a group of assets should be allocated to the bill of exchange. Brinson, Sainer and Beyaver (1991) showed that the asset policy on the average % 93,6 of the total fluctuation returns of the seasonal funds are explained while proper choice and evaluation of the marketing condition only explains trivial part of it. In other words, they concluded that the return of the total portfolio fundamentally is independent of the active management level. The researches of Brinson et al, convinced the investors that allocating the funds of the investment to the asset groups (choosing the main groups of assets) is far more important than allocation of individual bill of exchanges in each group of assets. (Smith, 1998)

Sharp in 1987, presented an integrated asset approach that considered both the market condition and the goals of the investor's asset. Even tough there might be similarities between the integrated allocation of asset approach, the standard and predefined process does not exist for its conduction and presentation. For example, how the marketing condition would be considered in the model? What model is used in the

asset return? How can the portfolio be formed based on the return and considered risk from the view point of the investor? All these questions and decisions remain for the investor and the manager to be answered.

Ibotson and Kaplan (2000) presented three questions considering the importance of asset allocation and tried to answer them. A) How much of the return variability in a period of time is explained by the allocating asset's policy? B) How much of the return variability between the funds are explained by the difference of the policies? The question is that whether there is any tendency for the policy to differentiate between the funds' performance?

D) Which part of the return level is explained by the return policy? This question is responded considering the ratio of the return policy model to the real return of the fund. They found that allocating the asset can explain 90 percent of the variability of the common investment funds, 40 percent of the fluctuation between the funds and 100 percent of the fund returns over a period of time. (Sedzroet al, 2012)

Tokat et al (2003) in a research analyzed the issue of multi- phase allocation asset under the fixed normal return scenario. They used the arbitrary programming and decision making rules to solve this issue.

Gupta et al in 2010 in a research combining the behavioral reports, the cluster analysis, the hierarchical analysis process and phase programming and mathematical models developed in the portfolio choosing issue.

In a research done in 2010 by Sedzro et al, a process was suggested that made the asset allocation integrated possible based on the hierarchical analysis process, mean-variance model, and ideal programming.

The Assumptions of Capital Assets Pricing Model

Capital assets pricing model (CAPM) is a set of predictions that involves expected parity returns for risk assets. In 1952, Harry Markowitz established the principles of modern investment portfolio management. After twelve years, William Sharp, John Litner and John Mousin developed Capital asset pricing model in their articles (Simaan, 1987).

The Assumptions of Capital Assets Pricing Mode are as it follows:

1. There are many investors. Every one of them has a pension that is slight compared to total pension of investors. Investors accept price; that is, price of the is not influenced by their transaction. This assumption is usually the assumption of complete competition in micro-economics.
2. All investors plan an identical maintenance period. Such a behavior is very superficial (feeble-mindedness) and ignores every possible event after the end of time horizon. Generally, superficial behavior is less than the optimal state.
3. Investments are limited to a set of financial assets that can be transferred, including stock, bond, loaning and borrowing arrangements without risk. Additionally, it is assumed that investors can attempt to loan and borrow without constant risk.
4. Tax investors do not pay any tax for return and there is no cost of transactions.

5. All investors rationally are maximizing the mean-variance, i.e., all of them use Markowitz investment portfolio model.
6. All investors analyzes similarly analyze the bills of exchange (they have homogeneous expectations or beliefs).
7. These assumptions indicate the component of "if" and "what happen if" analyses.
8. Investors have a portfolio and this investment portfolio is a representative of assets in market investment portfolio (M).
9. Investment portfolio is efficient on the frontier border and is also on the line of optimal capital allocation. Accordingly, capital market line (CML) is the best accessible allocation line.

The risk premium of market investment portfolio, the Beta coefficient of security bond in relation to the single risk premium of market investment portfolio is defined as follows:

Risk premium of market investment portfolio:

$$E(r_M) - r_f = \bar{A}\sigma_M^2 \tag{1}$$

Beta coefficient of securities related to market investment portfolio:

$$\beta_i = \frac{\text{cov}(r_f, r_m)}{\sigma_M^2} \tag{2}$$

And risk premium of each security bond equals:

$$E(r_i) - r_f = \frac{\text{cov}(r_f, r_M)}{\sigma_M^2}\left[E(r_M) - r_f\right] = \beta_i\left[E(r_M) - r_f\right] \tag{3}$$

Capital assets pricing model establishes a relation between a security bond risk or Beta and expected return rate level.

This model that is called security market line (SML) states the mentioned relation as following:

$$r_j = r_f + \beta(r_m - r_f) \tag{4}$$

σ_M^2 = Variance of market security bond

r_j = Expected Return (demanded) security bond

r_f = Expected Return on risk-free bill of exchange

r_m = Expected return of market investment set (like Stock Exchange index)

β = Beta is an indicator of non-diversification risk (uncontrolled or systematic risk)

β is the key component of capital assets pricing model (CAPM) that shows variability degree of hypothetical security bond return relative to variability of an security bond return (or market Beta that

equals 1). For example, the Beta value of 0.5 indicates that variability degree or the expected security bond risk degree is the half of average bill of exchange.

β = 1 indicates that the change pattern of the considered security bond or its risk is just similar to the average security bond and β 2 indicates that the change or risk level of the considered security bond is 2 times more than the average security bond risk.

The phrase of β (rm-rf) denotes spending risk or additional return demanded by investor to compensate a certain level.

To sum up, capital assets pricing model or security market line indicates that the expected return rate of an assumed security bond (rj) equals risk-free security bond (rf) plus spending a risk demanded by investors due to taking a certain level of risk. Higher systematic risk (β) degree leads to higher return demanded by investors on certain β βιλλ of exchange. Figure 1, namely security bond market line, indicates the relation between the expected return rate and various risk levels depicted with different βs.

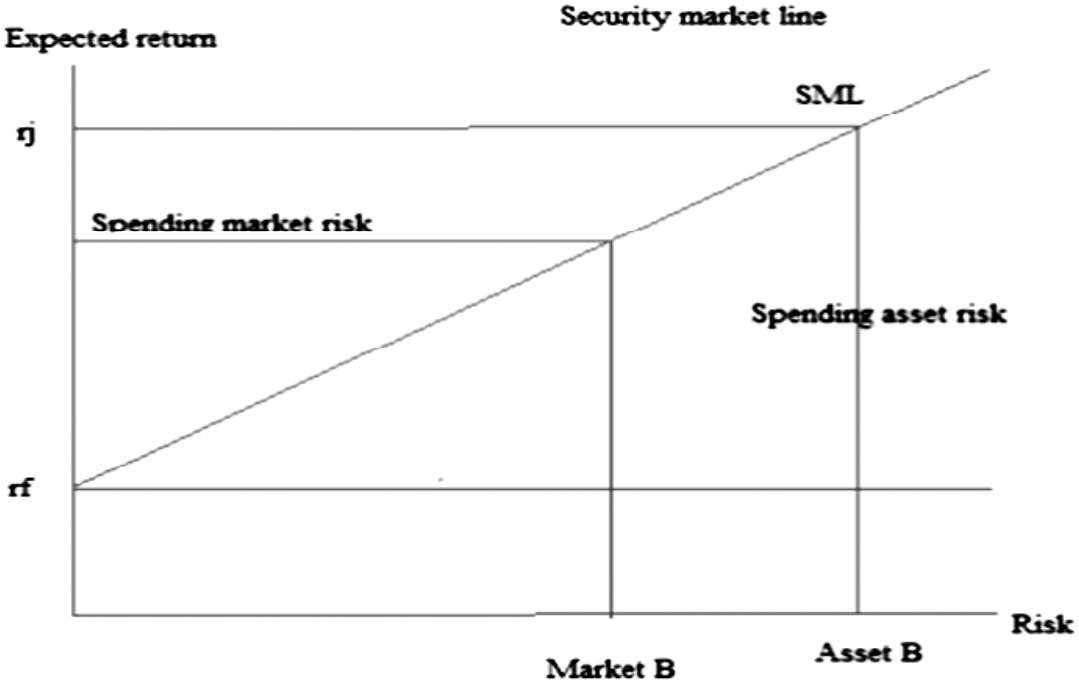

Figure 1: The relation between the expected return rate and various risk levels (Thanh Liem,2015)

RESEARCH METHODOLOGY

It is assumed that total volume of bank loans which are supposed to be allocated to customers during one year is allocated among customers with the ratio of X1, x2, ... , X10 in such a way to obtain that the maximum expected net present value in various ranges of risks. That is:

$$Max: E(npv)^T = \sum_{i=1}^{10} x_i npv_i \tag{5}$$

S.T:

$St.\ Dev^T = A$

Where $E(npv)^T$ indicates expected net present value of various loans; St. Dev^T indicates the standard deviation of loans combination portfolio that is regarded as risk index, and A indicates the maximum value of risk allowed in each scenario.

In this problem, NPV formula is used to compute net present value:

$$NPV_i = \sum_{i=0}^{n} \frac{R_{it} - C_{it}}{(1+r)^t} \tag{6}$$

Where R_{it} denotes cash income value due to i^{th} loans in t^{th} year; C_{it} denotes cash circulation of total capital and operational costs for i^{th} loans in t^{th} year, an r indicates discount rate that is determined exogenously and assumed identical for all projects. T also indicates operational time that is considered 5 years in this study.

To compute expected value and risk of each project, with respect to inevitable fluctuations in effective variables in the project's economy and to achieve more precise estimation, three scenarios were considered for loans' profit $\left(P_{it}^{E3}, P_{it}^{E2}, P_{it}^{E1}\right)$ with the occurrence probability percentage of $q_i^{E3}, q_i^{E2}, q_i^{E1}$; three scenarios for costs of each type of bank facility $\left(C_{it}^{E3}, C_{it}^{E2}, C_{it}^{E1}\right)$ with the occurrence probability percentage of $f_i^{E3}, f_i^{E2}, f_i^{E1}$, and three scenarios for the value of granted loans in that project $\left(Q_{it}^{E3}, Q_{it}^{E2}, Q_{it}^{E1}\right)$ with the occurrence probability percentage of $\left(b_i^{E3}, b_i^{E2}, b_i^{E1}\right)$. Therefore, there will be 27 scenarios and net present value in each scenario is obtained from the following equation. Hence, having 27 values for NPV with different occurrence probability percentages, the total NPV mean for the i^{th} project is computed as it follows:

$$NPV_i^E = \sum_{k=1}^{27} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{y=1}^{3} NPV_i^{Ek}.q_i^{Ej}.f_i^{Ei}.b_i^{Ey} \tag{7}$$

The weighted mean of NPV_i^E is regarded as economic value of projects' group. Also, the standard deviation of economic value of these projects, as a criterion for asset risk index is computed as it follows:

$$S.D_i^E = \sqrt{\frac{\sum_{j=1}^{N} \left(NPV_i^{Ej} - NPV_i^E\right)^2}{N-1}} \tag{8}$$

Thus, 27 scenarios are considered for each granted loans. That is, the above process is repeated for every type of the loans.

DATA ANALYSIS

Accordingly, and considering the presented data, the results of computation for the expected net present value, as an economic return index, and standard deviation, as the risk index, for projects' group are presented in Table 1:

To compute the allocation optimization for various alternatives, QM Software is used. Through conducting the regression, the returns of efficient portfolios over their risks, the function of efficiency

Table 1
Economic return indices and projects' group risk

Type of loans	*E(NPV)*	*Standard deviation*
Legal participation loans	2761	2611
Mosaqat loans	889	657
Civil participation loans	3209	2873
Free interest loans and depository	2872	2281
Contract of farm letting loans	1765	1367
Forward Purchasing loans	2872	2137
Leasing loans	4456	3453
Hire purchase loans	5012	3872
Contract of reward loans	3982	2187
Bailment of a capital loans	4209	1987

Source: Author's research

frontier for various values is obtained and it is as follows:

$$E(NPV1) = -183219 + 169 \times St.\ Dev^{1/2}$$
$$E(NPV2) = -18297 + 465 \times St.\ Dev^{1/2}$$
$$E(NPV3) = -376281 + 1028 \times St.\ Dev^{1/2}$$
$$E(NPV4) = -67287 + 652 \times St.\ Dev^{1/2}$$
$$E(NPV5) = -29874 + 1382 \times St.\ Dev^{1/2}$$
$$E(NPV6) = -109211 + 2219 \times St.\ Dev^{1/2}$$
$$E(NPV7) = -429832 + 178 \times St.\ Dev^{1/2}$$
$$E(NPV8) = -652311 + 298 \times St.\ Dev^{1/2}$$
$$E(NPV9) = -329811 + 1874 \times St.\ Dev^{1/2}$$
$$E(NPV10) = -423121 + 1098 \times St.\ Dev^{1/2}$$

On the other hand, to obtain capital market line, its latitude and slope should be obtained. Latitude of present value is the value of risk-free investment asset. In this state, the average value of total loans allocated to risk-free loans is considered without allocated time duration. This value for 10-fold loans equals 87291, 762831, 872323, 29839, 229837, 2983298, 3989348, 874989, and 912831 Rials. Therefore, capital market line for the problem is as follows:

$$E(NPV1) = 87291 + a1 \times St.\ Dev$$
$$E(NPV2) = 762831 + a2 \times St.\ Dev$$
$$E(NPV3) = 872323 + a3 \times St.\ Dev$$

$$E(NPV4) = 29834 + a4 \times St.\ Dev$$
$$E(NPV5) = 87239 + a5 \times St.\ Dev$$
$$E(NPV6) = 229837 + a6 \times St.\ Dev$$
$$E(NPV7) = 2983298 + a7 \times St.\ Dev$$
$$E(NPV8) = 3989348 + a8 \times St.\ Dev$$
$$E(NPV9) = 874989 + a9 \times St.\ Dev$$
$$E(NPV9) = 912831 + a10 \times St.\ Dev$$

According to the definition of capital assets pricing model (CAPM), optimal portfolio is a portfolio that is obtained from the contact point of the capital market line and efficiency frontier graph. For example, to find the coordinates of optimal point for legal participation loans of Melli Bank, the two following conditions should be met:

$$87291 + a1 \times St.Dev = -183219 + 169 \times St.Dev^{1/2}$$

$$St.Dev^{1/2} * a = 219$$

In this case, standard deviation equals 64397. Additionally in such condition, the expected return almost equals 165973 that equal asset portfolio selection with the combination of 1454 billion Tomans. The following table (2) presents the values computed for the referred loans.

Table 2
Optimal portfolio combination

	Expected present value	64397
	Standard deviation	165973
Combination	Legal participation loans	2238
	Mosaqat loans	1872
	Civil participation loans	5287
	Passive bonds and depository loans	2109
	Contract of farm letting loans	1988
	Forward Purchasing loans	1983
	Leasing loans	4987
	Hire purchase loans	4129
	Contract of reward loans	3565
	Bailment of capital loans	4109

Source: Research calculations

CONCLUSION

Assets portfolio optimization techniques, in addition to market stock, are increasingly spreading day-to-day in other sections. In this research, presenting a combinational method of optimization model, various

loans to customers were allocated. The results obtained from the computation of assets' portfolios revealed that the higher the expected return and risk, it leads to the tendency toward the allocation of value towards civil participation loans, hire purchase and leasing and bailment. Even though the estimated combination is introduced as a model for Bank, it should be considered that in Melli Bank of Iranas one of the greatest governmental banks of Iran, the only argument is not being profitable and mainly the governmental assigned loans play a significant role in allocation of financial resources.

Additionally, considering the Islamic banking system that is dominating our country's banking system, some of these loans due to the related Islamic laws and lack of practicality realization have trivial status in the investment, for example Mosaqat and Contract of farm letting loans, which are two financial providing sources in agriculture, have less share in compare to other contracts in our combination model and in all banks these contracts have been used less. While Forward Purchasing loans also have less share in our model in compare to other contracts but have acceptable status among the bank loans. Thus, the Islamic laws related to every one of the loans have a significant role in the amount of investment in that group of the loans.

On the other hand, the integrated approach provides this possibility for the numerous investors including the professional and unprofessional to allocate the assets simply and flexibly and appealing to the user. The user appealing feature and the simplicity of the approach leads to its widespread use in the investment issues whether theoretically or in the real world. But since the allocation of the asset is a multi-criteria decision-making process, it is proposed to be used in the following research with a new model combining the mentioned method with econometric methods and multi-criteria decision-making model.

According to the obtained results in this research, it can be stated that CAPM Model, in fact provides the opportunity of investment for the investors and this issue would help the investors to decide for the investment. Also, it can be said even though this model might provide poor estimation, it s clear that it is far more comprehendible than similar models

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Appendix: A variety of loan scenarios

Type of Facility	*Interest rate scenarios*	*Cost scenarios (percentage without considering the inflation rate)*	*Scenarios of loan volume*
Legal participation loans	22%	5%	120000
	20%	4%	100000
	18%	3%	800000
Mosaqat loans	22%	5%	100000
	20%	4%	800000
	18%	3%	600000
Civil participation loans	22%	5%	120000

(*contd...Table Annexure*)

Type of Facility	*Interest rate scenarios*	*Cost scenarios (percentage without considering the inflation rate)*	*Scenarios of loan volume*
	20%	4%	100000
	18%	3%	800000
Saving and deposit loans	12%	5%	35000
	10%	4%	30000
	4%	3%	25000
Contract of farm letting loans	22%	5%	120000
	20%	4%	100000
	18%	3%	80000
Forward Purchasing loans	20%	5%	250000
	18%	4%	220000
	16%	3%	190000
Leasing loans	20%	5%	350000
	18%	4%	310000
	16%	3%	270000
Hire purchase loans	22%	5%	450000
	20%	4%	400000
	18%	3%	350000
Unilateral Contract loans	22%	5%	1000000
	20%	4%	850000
	18%	3%	700000
Bailment of a capital loans	22%	5%	1000000
	20%	4%	850000
	18%	3%	700000