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Investigate the Optimal Combination of Bank Credit Portfolios by Using Firefly Algorithm (Case Study of agricultural bank)

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Abstract

One of the main activities of banks is the allocation of resources, one of the main aspects of which is determining the optimal combination of credits to various economic sectors. Lack of attention to the allocation of financial resources available to the bank, can cause serious damage to the entire economic system. In this study with the purpose of determining the optimal portfolio of the bank, each of the different activities of the creditor was considered as an asset. Given that the fluctuations in the ratio of lending credits collection are the main source of expected bank earnings fluctuations, so the amount of lending credits of each economic activity, which need to be collected are considered as return standard of, and its variance is consider as a risk. Also, in order to determine the range of expected return on assets, the historical average on each asset is calculated. Considering the necessity of reviewing this issue, in this paper, a multi-objective non-linear programming model using the firefly algorithm has been used to determine the optimal portfolio of agricultural bank credits. The main features of this research are the consideration of three optimistic pessimistic and hybrid strategies under different economic conditions. The results showed that the optimal pattern obtained from the firefly algorithm differs from the current model of distribution of bank credits.The present findings can provide managers with a roadmap for choosing the optimal portfolio consistent with the bank's preferences according to different estimates of return and risk, thus leading to the proper management of loans

Keywords: Optimization, Return, Interval Programming, Strategy, Agricultural Bank

JEL Classification: C02, G11, G15

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1.**introduction**

In most countries, governments or financing institutions are responsible for providing credit to agricultural actors (Monsef & Tabatabay, 2013:323). In addition to their main function, which is to mediate funds, banks must invest in a way that maximizes the profits of shareholders and depositors. Banks to increase shareholder wealth should be invested in ways that have the greatest return. But since return is directly related to risk, in order to get more return, they must also accept the risk (Mashhadian maleki et al., 2020:156). Given that there are several risks in banks, the bank should reduce its investment risk by using the right portfolio, because one of the most important reasons for the weak performance of the bank is related to the issue of loan portfolio management.

Credit portfolio management in banks is a continuous process of evaluating and taking advantage of various lending opportunities in order to achieve maximum return within the framework of macro management objectives, along with accepting the minimum risk. The most important components of a credit portfolio management model are the return and risk of various lending opportunities in various economic activities. If a model is not designed for this issue and it is not used, in other words, in the credit portfolio of banks, the allocation is not done properly, they will go bankrupt in the long run. Therefore, the role of model design to determine the credit portfolio of banks and financial and credit institutions is very sensitive and key (Asgarzadeh, 2007:109). In this paper, in order to determine the optimal loan portfolio of Keshavarzi Bank, a multi-objective nonlinear programming model has been used using firefly algorithm.

2. An Overview of Empirical Studies

What can be seen in previous studies is modeling without considering different economic conditions.

For example, Salami and Bahmani (2003) used the expected income method - Variance, Abu Nouri et al. (2015) and Javo (2001) with the help of mathematical planning model to allocate bank credits.

3. Method

3-1. Data description

In this study, each of the activities or different sectors receiving the credit was considered as an asset or investment project. Data were collected from 2009 to 2014. Since the main source of fluctuations in the bank's expected income is the fluctuation in the ratio of collection of credit for facilities given out, the ratio of collection of credits awarded to each economic activity to what should be collected was taken as the return criterion and its variance as the risk. In this study, in order to determine the range of expected return on assets, financial reports, historical information of assets and expert opinions have been used.

Thus, first the average historical return (ri) of each asset was calculated and then the following three cases were considered:
1) All rates of return on risky assets are located to the left of the historical average values of return on assets, which are the reference points and is in accordance with bad economic conditions.
2) All rates of return on risky assets are selected so that the average historical returns of each asset that are considered as reference points are placed between them and are consistent with a stable economic condition.
3) All rates of return on risky assets are selected to the right of the average historical returns of each asset that are considered as reference points and are consistent with good economic conditions.

3-2. Optimal portfolio selection

The problem of interval multi-objective optimization studied in this research is solved using the weighting method in the following 3 strategies:
1. Optimistic strategy: In this strategy, the investor calculates the return and optimistic risk of the assets.

$$Min\ \mathrm{Fl} = \alpha \sum_{i=1}^{N}\sum_{j=1}^{N}[\sigma 2\mathrm{ijl}] - \beta \sum_{j=1}^{N}[\mathrm{Riu}] \quad (1)$$

Subject to

$$\sum_{i=1}^{17} Xi \leq 189336089818750$$
$$X10 \leq 18933608981875$$
$$Xi \leq 0.21$$
$$Xi \geq 0.001$$

2. Pessimistic strategy: In this strategy, the pessimistic return and risk of assets are calculated by the investor.

$$Min\ \mathrm{Fr} = \alpha \sum_{i=1}^{N}\sum_{j=1}^{N}[\sigma 2\mathrm{iju}] - \beta \sum_{j=1}^{N}[\mathrm{Ril}] \quad (2)$$

Subject to

$$\sum_{i=1}^{17} Xi \leq 189336089818750$$
$$X10 \leq 18933608981875$$
$$Xi \leq 0.21$$
$$Xi \geq 0.001$$

3. Combined strategy: This strategy is a combination of both optimistic and pessimistic strategies. The investor in this model tries to balance the performance of returns and risk of assets.

$$Min\ F(x) = \lambda Fr(x) + (1 - \lambda)Fl(x) \quad (3)$$

Then

$$Min\ F(x) = \lambda[\alpha \sum_{i=1}^{N}\sum_{j=1}^{N}[\sigma 2iju] \ - \beta \sum_{j=1}^{N}[\mathrm{Ril}] + \ (1 - \lambda)[\ \alpha \sum_{i=1}^{N}\sum_{j=1}^{N}[\sigma 2ijl] - \beta \sum_{j=1}^{N}[\mathrm{Riu}]$$

Subject to

$$\sum_{i=1}^{17} Xi \leq 189336089818750$$
$$X10 \leq 18933608981875$$
$$Xi \leq 0.21$$
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In which α and β are the risk and return weights and λ the pessimistic index on a scale of 0 to 1, and the model is solved by assigning different values (between 0 and 1) to them, and the investor chooses a different model based on the different estimates of return and risk. The limitations considered in this research include capital adequacy limit, central bank legal limit and minimum and maximum share restrictions of each economic sector.

4.Results

The results of the study showed that the optimal model designed using the firefly algorithm is different from the distribution of agricultural bank credits in the current situation. As in the optimal model designed in this study, the sectors of agriculture, services, agriculture, animal husbandry, Aviculture and greenhouses have the largest share in the composition of the optimal credit portfolio. As can be seen, one of the major differences in the estimated optimal portfolio compared to the current model is the location of the greenhouse sector among the sectors to which a larger share of credit should be allocated. Since the development of greenhouse products plays a special role in increasing the quantity and quality of agricultural production, increasing productivity in the use of lands and production inputs, promoting food security, creating productive employment and valuation, it is necessary to allocate more funds to this sector.

5. **Conclusions**

The results showed that the current credit distribution model of this bank is different from the estimated optimal model and in this respect is similar to previous studies conducted in this field (Salami and Bahmani,۲۰۰۴; Jao, 2001). Applying the strategies presented in this research has improved the attitude of bank managers and their preferences towards different types of investments under certain conditions so that they can choose their optimal strategy according to the importance and role of returns and risk.

References:

Abounoori, A., Mirzaei, h. and Hamouni, P. (2018). "Determine the optimal portfolio of Bank Keshavarzi Iran using Goal programming". *Journal of Financial Engineering and Securities Management*,9(35):1-18. (in persian)

Asgarzadeh, Gh. (2006). "Mathematical Modeling to Determine the Optimal Composition of Credit Facility Portfolios in Financial and Credit Institutions". *Andisheh Sadegh Quarterly*,Vol. 23, pp. 107-130. (in persian)

Eshraghi samani, R., Sheykh mohammadi, F. and porsaeid, A. (2016). "Factors affecting the non-repayment of agricultural bank facilities by farmers Case: Ilam city". *Journal space economy & rural development*. 4(2):77-91. (in persian)

Jao Y.C. (2001). "Linear programming and banking in hong kong". *Journal of Business Finance and Accounting*, 7: 489-500.

Mashhadyan Maleki, M.R., Souri, A., Ebrahimi, M., Mehrara, M. and Majed, V. (2020). *Applied Economics Studies, Iran (AESI)*,8(35):155-173

Monsef A., Tabatabay S.M. (2013). "Optimum allocation of the bank resources and consumptions using linear planning technique: evidence from qavamin bank in Iran". *Asian Journal of Research in Business Economics and Management* 3: 322- 334. (in persian)

Salami, H. and Bahmani, A. (2004). "Optimizing the composition of investment activities in the Agricultural Bank". *Iranian Journal of Agricultural Sciences,2:401-408.* (in persian)