Learning a Selection Problem of Investment Projects and Capital Structure through Business Game

Yasuo Yamashita, Hiroshi Takahashi, and Takao Terano

Abstract. While the importance of financial education increases in recent years, the technique for deepening an understanding of finance theory is needed. In this research, we analyze learning method of the finance theory about the investment project selection and capital structure determination using the business game technique. As a result of analysis, the participant understood the investment project selection method and interesting phenomena – an understanding progresses about the method of determining the capital structure which raises capital stock value – were seen. These results show the effectiveness of the business game technique to study of finance theory.

1 Introduction

In recent years, as asset management market in Japan is increasing, Japanese asset management business is developing quickly. In addition to riskless assets, for example, cash, on asset management business, it is paid attention to invest to riskier financial products including an investment fund. In such current to the investment from the savings, in the asset management business industry, the need for personnel training is strongly recognized in order to heighten an asset management capability. The research [13] which focused on a financial investment theory centering on

Yasuo Yamashita
Department of Computational Intelligence and Systems Science,
Tokyo Institute of Technology, Japan
e-mail: yyasuo1@yahoo.co.jp

Hiroshi Takahashi
Graduate School of Business Administration, Keio University, Japan

Takao Terano
Department of Computational Intelligence and Systems Science,
Tokyo Institute of Technology, Japan

K. Nakamatsu et al. (Eds.): New Advan. in Intel. Decision Techno., SCI 199, pp. 41–50.
springerlink.com

risk return analysis is accomplished in the viewpoint of the personnel training in asset management business. But, there are not enough researches on learning of a finance theory. From a money manager's position, it is hard to notice the problem from a business administrator's view because money managers analyze corporate management from the view with security analysis, such as stocks and a corporate bond. Although especially known as knowledge by study by books and so on about the argument in finance theory, it is hard to say that an understanding is deepening enough to the application to actual decision-making[1]. It is required to deepen an understanding of main arguments in finance theory called the investment project selection and capital structure selection, which are the analysis objects of this research in order to raise management capabilities in severe investment competition.

On the other hand, it is hard to say that the research on finance with business game is done enough[4], and application of business game to finance research is expected. Business game is one field of gaming simulation[5], which is used to the research on management or marketing[12][11][10]. It is meaningful to do research on study of the finance using the business game technique for these reasons. In this research, it aims at showing the technique of learning the investment project selection and capital structure selection about finance theory using the framework of business game . Firstly, the model of the business game based on finance theory was built, and subsequently it experimented by using an actual human being as a player. In the following section, after explaining the model used for analysis, a result is shown in Section 3. Section 4 is a conclusion.

2 Method

2.1 System of Business Game

Environment required for development of the system in this research, and execution of an experiment is constituted by business model descriptive language (BMDL) and business model development system (BMDS)[9]. BMDL is the programming descriptive language of a short form. HTML files, CGI files, and so on can be created in BMDS[2] by describing BMDL for game managers (facilitator) and for game users (player). Fig. 1 shows development and execution environment of an experiment. Players input decision-making in each round through WWW browsers, and a facilitator also advances a game through a WWW browser.

2.2 Model of Business Game

Corporate management could be asked for various decision-making. In this research, the business game is built, which focused on the investment project selection

[1] About the argument in finance theory, it is referring to the reference[8][1].

[2] BMDL is changed and used in part so that the experiment of this research may be possible.

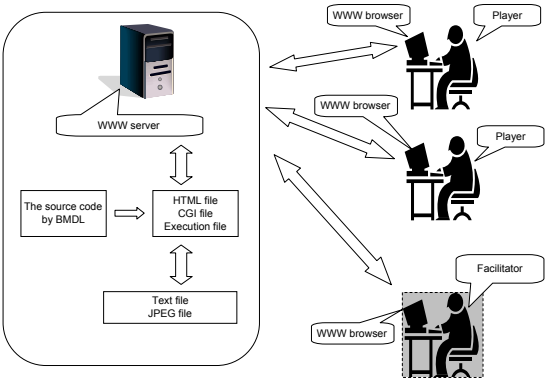

Fig. 1 Conceptual diagram of development and execution environment of experiment

and capital structure selection of the company which are the main problems of finance theory.

According to finance theory, it is known that the project selection method which makes stock value the maximum should just choose the project which makes the maximum the investment-amount weighted average expected return. The certain investment project exists in the investment project of a company. That investment project can usually be called main occupation and should be continued and invested. Therefore, in the model of this research, when choosing an investment project, there is a certain invested project[3], to be considered as a setup near the actual investment project selection situation.

In finance theory, there is Modigliani-Miller theory (MM theory) as most fundamental theory about the capital structure of a company[6][7]. According to MM theory, it is known that stock value will not be based on capital structure in a complete market. Here, a complete market is the market that does not have the asymmetric information of a tax, a bankruptcy risk between investors and managers. However, in an actual market, since there are a tax and a bankruptcy risk, stock value is influenced by capital structure. When there is a tax to the profits of a company, stock value can be raised by raising debt ratio. However, since there is bankruptcy cost in a debt financing, if not much many debts financing are performed, expense will increase, and on the contrary a result of stock-value reduction is brought[4].

According to finance theory, it is known that there is optimal capital structure which makes stock value the maximum. As decision-making, it carries out by specifying the amount of money of a debt and stocks. The kind of debt is assumed to be borrowing which does not specify but makes one round (one period) the due date, or a thing like a corporate bond. Moreover, in this experiment, there are asummed to be no transaction cost and no issuance cost for debts or stocks. Also in this experiment, there is the optimum capital structure which makes stock value the maximum in

[3] Although it is common to make decisions investment in the investment project in an actual company about the project from which an investment period differs, such analysis is a future subject.

[4] I would like to make analysis using the knowledge of behavioral finance[2][3] into a future subject about the case where there is asymmetric information of an investor and a manager.

raising the funds for an investment projects. In the business game of this experiment, closer to such optimal capital structure the player's one is, more the stock value can be raised, and made it possible to learn about the capital structure method which raises stock value. The business game in this experiment specifically advances as follows.

A player is provided with expected returns, risks and investment amounts and so on, of 11 investment projects. Those investment projects include an initial investment project as reference information at the beginning of every round. A player refers to such reference information and chooses investment projects which make stock value the maximum. Although the continuation investment project is considered as the always invested project, selection of the other investment project is arbitrary. It is also possible to choose all the investment projects or to choose no investment projects as an extreme example.

Each player decide whether an investment project is "invested" or "not invested". Next, a player determines the amount of financing according to an investment project amount as input of the capital structure "debt amount" and "stock amount." Extra-items are also created as input variables used inside the model of business game. The purpose is investigating the thinking of a players. A player selects the top 3 items from the 20 items when a player makes decisions from what has a high priority. Determination of the investment project of all the players and the input of capital structure will perform the update process which calculates a stock price, a debt ratio[5] and so on according to internal model.

Output informations are displayed on each player. Output informations are a stock price, a debt ratio, ranking and so on. Since ranking promotes competition between players, it is displayed on each player by making ranking based on the stock return of each round by a stock price, an accumulation stock return, ranking and so on into output information. Credit rating is estimated by the credit-spread calculated inside a model. Evaluation of the credit-spread is beforehand given to the model as exogenous information.

The player is given as a purpose raising the stock price of a company as much as possible. A stock price is calculated according to the input of a player based on finance theory inside a model. About selection of an investment project, there is the optimal solution which makes a stock price the maximum for every round. It is the structure where a stock price increases, so that selection of the investment project of a player is close to an optimal solution. In Fig. 2, the investment project 0 is a continuation investment project, and it is considered as the investment project which can be chosen from the investment project 1 to the investment project 10. About the 1-10 investment projects, it is assumed that a number is assigned to the high order of an expected return. It means that the number of the horizontal axis of Fig. 2 chooses from the investment project 1 to the investment project of the number in addition to the continuation investment project 0. A vertical axis is an amount-weighted expected return. In the example of Fig. 2, when the investment projects

[5] Debt ratio = Debt amount / Stock amount.

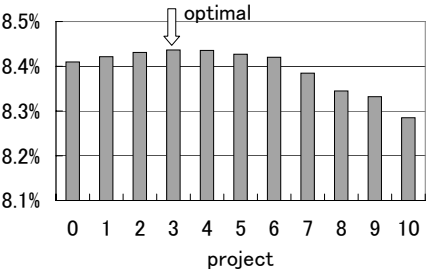

Fig. 2 Example of optimum investment project

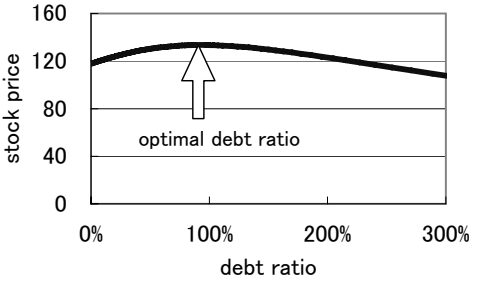

Fig. 3 Example of optimum debt ratio

1, 2, and 3 are chosen, a weighted average expected return serves as the maximum, and serves as an optimal solution.

Moreover, there is the optimal solution to which capital structure selection also makes a stock price the maximum according to the amount of an investment project. It is a setup with an increasing stock price, so that capital structure selection of a player is close to an optimal solution. In Fig. 3, at least 90% of the debt ratio from which the stock price is the maximum serves as an optimal solution.

All players made decisions under the same parameter conditions, and the parameter conditions during a round experimented by setup of being independent. The present decision-making is a setup which is not influenced by the past decision-making.

Business game of the above contents was carried out twice. Players are 4 institutional investor's affiliation members (all the members is financial analyst holder)[6]. The time for explanation of introduction and an experiment and decision-making of a round 1 is taken about 30 minutes. The players repeat decision-making of each round every about 10 minutes. One experiment took about around 2 hours[7]. A player was not told about the number of times of an end of a round, but it was decided to be an end in about 2 hours. Therefore, it is ended at eight rounds as a result.

[6] The experiment by 12 department-of-economics students is conducted twice as preparatory experiments. As for the decision-making item of this research, there were those who express the comment that it is more difficult than the experiment[13] only for securities investment theory among participants in order also to have to determine capital structure in addition to investment.

[7] This experiment is conducted as part of operating training, and the incentive to experiment participation of a player is maintained at the sufficiently high level.

3 Result

Explanation about an experimental result is given in this chapter. First, it explains that there was learning effect about investment project selection. Subsequently, it is explained that there was learning effect also about capital structure selection.

3.1 Investment Project Selection

This section explains that there was learning effect through this experiment about investment project selection.

Figs. 4 and 5 show transition of ”the stock return by investment project selection” (it is called this ”p return” hereafter) in experiment 1 and experiment 2. ”The stock return by investment project selection” is the rate of change of the stock price evaluated in the market according to selection of the investment project which the player determined.

”Optim” in a figure is p return at the time of making investment project selection which makes a stock price the maximum. The investment project selection in this case is henceforth called an ”optimum investment project”. And ”a” to ”d” is p return of each player. P return of each player has deviated from p return of ”optim” in Fig. 4. In Fig. 5, it has overlapped with p return of ”optim” mostly. Although

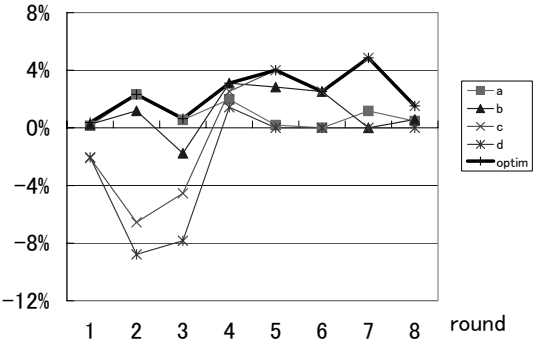

Fig. 4 p return of experiment 1

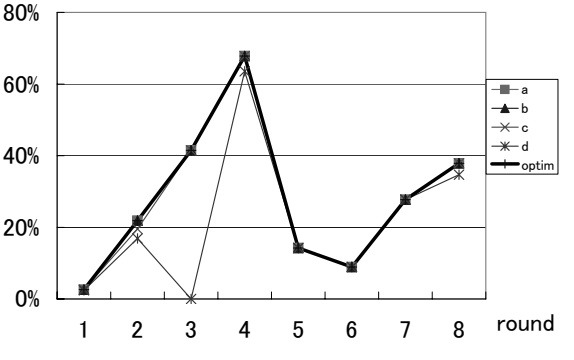

Fig. 5 p return of experiment 2

Table 1 Average of p return rate of deviation

Experiment	a	b	c	d	median	Difference of a median
1	1.51	1.29	2.11	4.47	1.81	–
2	0.00	0.00	0.24	4.81	0.12	1.69*

Unit:%.

*It is significant at a 5% level. median test (one side).

investment project selection to which a player raises a stock price was not made of experiment 1 as for this, it shows that it was learned in the experiment 2. This is an interesting result.

Table 1 is the verification that the players learn the investment project selection method effectively through the experiment 1 and the experiment 2. A significant difference is observed in the median of all the players of the rate of deviation[8] of p return by the level 5% in experiment 1 and experiment 2. And it shows that the experience of the investment project selection through business game has an effect by this experiment.

About the selection method of an investment project, if the player is an institutional investor's employment section affiliation member, he or she should usually know the selection method with books and so on as basic knowledge. However, as checked in the experiment 1 of this research, when it was shown as a problem of "reality", there was the phenomenon in which the right investment project could not immediately be chosen even if the player was knowledgeable. It is surmised by experiencing quasi-reality through the technique of business game that the player's understanding is deepening about the selection method of an investment project so that it may be suggested in experiment 1 and experiment 2. There is meaning which just uses the business game technique in such a case.

From the questionnaire after an experiment, we has also actually obtained the reply that an understanding deepened about the selection method of the investment project from all the players. It seems to be effective technique by this research to learn investment project selection through business game.

3.2 Capital Structure Selection

This section explains that there is the learning effect through this experiment about capital structure selection.

Figs. 6 and 7 show transition of the debt ratio of the player of experiment 1 and experiment 2, respectively. "Optim" in a figure is a debt ratio (the optimum debt ratio) which makes a stock price the maximum. And "a" to "d" is a debt ratio of each player. As compared with Fig. 6, it seems that deviation of the debt ratio of each player from the optimum debt ratio has decreased in Fig. 7.

[8] "Rate of deviation of p return" =("p return of optim" - "p return of player")/(1+ "p return of optim") defines the rate of deviation of p return.

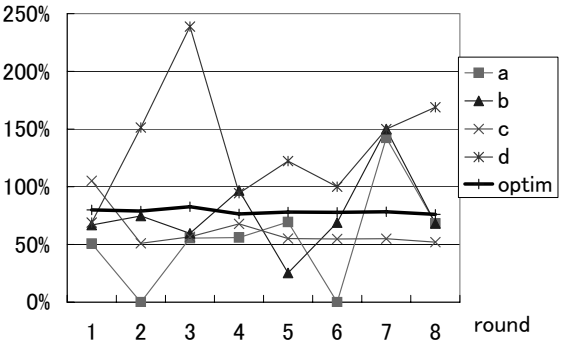

Fig. 6 Debt ratio of experiment 1

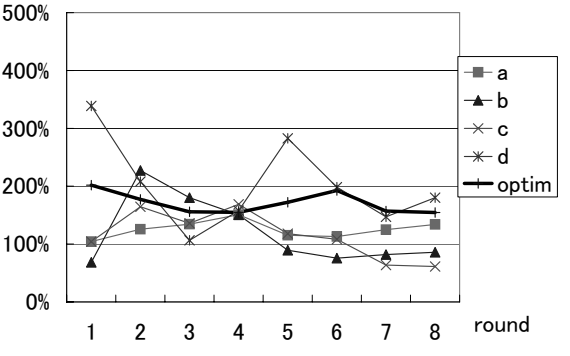

Fig. 7 Debt ratio of experiment 2

Table 2 Tracking error of debt ratio rate of deviation

Experiment	a	b	c	d	median	Difference of a median
1	61.3	43.2	29.6	94.9	52.2	–
2	29.2	44.3	39.9	35.9	37.9	14.3*

Unit: %.
*It is significant at a 5% level. median test (one side).

Table 2 is the verification that the players learn the capital structure method effectively through the experiment 1 and the experiment 2. The significant difference is observed in the median of all the players of the tracking error of a debt ratio rate of deviation[9] by the level 5% in the experiment 1 and the experiment 2. And it shows that the experience of the capital structure selection through business game has an effect by this experiment.

Although it is known that there is the optimum debt ratio to which a player makes a stock price the maximum about a capital structure selection method from before experiment implementation, the concrete determination method cannot have been

[9] ”Rate of deviation of debt ratio” = (”debt ratio of player” - ”optimum debt ratio”) / ”optimum debt ratio” defines the rate of deviation of a debt ratio.

learned. Inside the model of business game, stock price evaluation is performed based on finance theory. Therefore, if a player gets to know details and there is sufficient time calculable by self, it will be thought that the optimum debt ratio was able to be drawn. However, the time given to the player for every round in the experiment is about 10 minutes. Hence, it is thought that the players use the different methods of calculating the optimum debt ratio.

Actually, there are some players who answer that they think the past data of other teams as important as items when players make decisions. It is thought that the basis of restrictions that it must make decisions for a short time, and the player learned the decision-making method that the optimum debt ratio was approached while applying a trial-and-error method for restrictive information. Also in an actual market, it is common that the quality and quantity of information are restricted, and referring to indexes , such as a debt ratio of the other company within a same sector, is often used in business. In this experiment, the interesting result that the repeatability of a market is realizable, is obtained with the point that the players use heuristics (which is used in such an actual market).

4 Conclusion

It is shown that the use of the business game technique is effective in study of the finance theory about investment project selection and capital structure selection. About investment project selection, the player's understanding is deepened by experiencing business game, and it is shown that the experience of the investment project selection through business game is effective. About capital structure selection, it is shown that the experience of the capital structure selection through business game is effective.

References

1. Brealey, R., Myers, S., Allen, F.: Principles of Corporate Finance. McGraw-Hill, New York (2006)
2. Constantinides, G.M., Harris, M., Stulz, R.M. (eds.): Handbook of the Economics of Finance: Financial Markets and Asset Pricing. North-Holland, Amsterdam (2003)
3. Eckbo, B.E. (ed.): Handbook Of Corporate Finance: Empirical Corporate Finance. North-Holland, Amsterdam (2007)
4. Faria, A.J.: Business simulation games: Current usage levels—an update. Simulation & Gaming 29, 295–308 (1998)
5. Greenblat, C.S.: Designing games and simulations. Sage Publications, Inc., Thousand Oaks (1988)
6. Modigliani, F., Miller, M.: The cost of capital, corporation finance and the theory of investment. American Economic Review 48, 655–669 (1958)
7. Modigliani, F., Miller, M.: Corporate income taxes and the cost of capital: A correction. American Economic Review 53, 433–443 (1963)
8. Ross, S., Wester, R., Jaffe, J.: Corporate finance. McGraw-Hill, New York (2005)

9. Terano, T., Suzuki, H., Kuno, Y., Fujimori, H., Shirai, H., Nishio, H., Ogura, N., Takahashi, M.: Understanding your business through home-maid simulatior development. Developments in Business Simulation and Experimential Learning (26), 65–71 (1999)
10. Tompson, G.H., Dass, P.: Improving students' self-efficacy in strategic management: the relative impact of cases and simulations. Simulation & Gaming 31(1), 22–41 (2000)
11. Walters, B.A., Coalter, T.M., Rasheed, A.M.A.: Simulation games in business policy courses: is there value for students? Journal of Education for Business 72(3), 170–174 (1997)
12. Wolfe, J.: The effectiveness of business games in strategic management course work. Simulation & Gaming 28(4), 360–376 (1997)
13. Yamashita, Y., Takahashi, H., Terano, T.: The development of the financial learning tool through business game. In: Lovrek, I., Howlett, R.J., Jain, L.C. (eds.) KES 2008, Part II. LNCS, vol. 5178, pp. 986–993. Springer, Heidelberg (2008)