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Abstract (Doctor)

Title of Thesis	A STUDY ON OPTIMAL INVESTMENT IN NEW ENERGY INDUSTRY OF MYANMAR (ミャンマーの新エネルギー産業への最適投資に関する研究)
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Approx. 800 words

Energy is necessary for socio-economic development. Growth in energy demand increasingly comes from developing economies, including Myanmar. On the other hand, the energy mix is seriously getting shift towards lower carbon fuels for supporting ecosystem, the climate adaptation and technological advances. Currently, 57% of total population in Myanmar is still deprived of access to electricity although endowed with renewable and non-renewable energy resources. As Myanmar is a developing country, it needs innovative modern technology with huge capitalization in energy sector to be a developed nation.

The research questions are that what kinds of irreversible investment decision make financially optimal under uncertainty, how it is possible for Myanmar to invite foreign technology and investment from a perspective of win-win relationship and finally how Bayesian method would be a useful framework to estimate the parameters and clarify the signaling of investment in new energy industry.

In this thesis, a combination of option-games and Bayesian analysis will be utilized to analyze the optimal investment strategies for high-tech energy industry which needs huge irreversible capitalization and involve a great deal of uncertainty with asymmetric information among competitors. Particularly, managerial flexibility is connected with the Real Options Analysis. In Game Theory, the final realization of competition and cooperation tends to achieve "win-win" relationship with partners. Then, Bayesian MCMC Analysis is useful to the parameter estimation of the risk factors even when using incomplete information. Bayesian method has its advantage of signaling effect over the options-games theory of asymmetric information among competitors. Using options-games and Bayesian method to analyze the condition of two firms in clustering cooperation solves the problems between open innovation for advanced energy technology and cluster formation of the firms rationally.

In dissertation, one-stage strategic investment model is the introduction to the option-games between two players. In this model, option without competition, propriety option, has the implication of incentive to delay investment under uncertainty. But, option with competitive reactions has the timing trade-off between early commitment and flexibility value.

In two-stage option-games models, market structure is assumed to be oligopoly, duopoly in this case, where firm A is the pioneer and firm B is the follower. Firm A and B take actions in R&D commercialization period. The results show that a joint research venture enabling the firms to cooperate in R&D based on reciprocity during

the second stage can be the successful strategy for future growth in aspects of their market size. Then, it can save the R&D cost at favorable condition and can stay flexibility by waiting under unfavorable condition. By other words, firms of cooperation can get the win-win survival by the sharing strategy for uncertain condition. However, it needs to remove opportunism and improve the incentive for pioneer's entrepreneurial initiative.

Then, the Bayesian MCMC analyses are made as the parameter estimation in order to find the optimal energy mix for safe and secure electricity supply and, to examine the R&D investment continuity of new energy start-ups at the 'Valley of Death'. The flood disaster analysis is made for the risk management from the building of dams for hydroelectricity and also to figure out the best energy mix in electricity supply. In order for the stable supply of electricity all the seasons, solar electricity is an interesting renewable energy source in a dry zone like Myanmar as a backup to hydroelectricity. The revenue analysis from Bayesian perspective pointed out how much amount of investment should be made in new energy industry and how to continue the investments in negative financial period. At that time, firm's revenue as the sort of real options can be guideline to facilitate the risky but promising investments.

Since it has to invite the outside investors to invest in new energy project, two-players' game is extended for perfect competition between the competing firms under incomplete information. With information asymmetry in attracting to invest in a project, firm of better information tries to signal the project quality to the competing firm by acquiring patent as signaling game of perfect Bayesian equilibrium.

As the next challenge for my research, Bayesian inferences on stock returns and a Bayesian Regression Analysis for the potentiality to make the R&D investment in new project will be tried by referring to a study on opportunity for the sustainability of energy industry from a viewpoint of jump valuation.

The thesis concludes that there are ample opportunities for regional cooperation and technological innovation for new energy industry between advanced foreign countries including Japan and Myanmar in the development of renewable sources of energy. One of the conclusions of this thesis is that strategic cooperation with Japan would help Myanmar in strengthening energy related infrastructures and sourcing modern technology. I propose the result to appear sufficient generation and stable supply of electricity and then, a vision for the new energy project as the regional development in Myanmar.