様　式　Ｃ－１９、Ｆ－１９－１、Ｚ－１９　（共通）

科学研究費助成事業　　研究成果報告書

令和　２ 年　 ９ 月　 ７ 日現在

機関番号：１４３０１
研究種目：若手研究(B)
研究期間：2017～2019
課題番号：１７Ｋ１３６９９

研究課題名（和文）Experimentation in Organizations

研究課題名（英文）Experimentation in Organizations

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交付決定額（研究期間全体）：（直接経費）　　1,900,000円

研究成果の概要（和文）：This project provides an analytical framework for this complex process to shed light on how radical innovations are developed and materialized in organizations and how the collective incentive to experiment with new ideas is shaped by organizational factors.

研究成果の学術的意義や社会的意義
This project provides new insights and implications that help us better understand how innovations are motivated and generated in a complex organizational environment. Understanding the internal organizational structure of innovation is also crucial for deriving policy implications.

研究成果の概要（英文）：Innovation is a consequence of a process that are both collective and dynamic, involving decisions of various individuals at different stages. This project provides an analytical framework for this complex process to shed light on how radical innovations are developed and materialized in organizations, as well as how the collective incentive to experiment with new ideas is shaped by organizational factors. The paper "Dynamic Performance Evaluation with Deadlines: The Role of Commitment" was published in Journal of Industrial Economics, and the paper "Hierarchical Experimentation" was published in Journal of Economic Theory in 2018. The paper "A War of Attrition with Experimenting Players" is forthcoming in Journal of Industrial Economics, and papers "An Entry Game with Learning and Market Competition" and "Reputation Concerns in Risky Experimentation" are under submission.

研究分野：dynamic games with incomplete information

キーワード：experimentation　bandit problem

様　式　Ｃ－１９、Ｆ－１９－１、Ｚ－１９（共通）

１．研究開始当初の背景

In literature, while a bunch of papers apply bandit problems, which are Bayesian decision models that allow knowledge acquisition through experimentation, to study innovation, a growing number of papers are devoted to characterize the optimal contract to motivate innovation.

(1) In the literature of experimentation in teams, Bolton and Harris (1999), Keller, Rady, and Cripps (2005), and Bonatti and Horner (2011), consider the case where a team of homogeneous players collaborates on a common project. Players can observe each other's outcome. Hence, information is a public good, and as a result, a free riding problem and under-experimentation is present in equilibrium. The payoffs, however, are exogenously given. Therefore, the optimal rewarding scheme is not discussed.

(2) In the literature of experimentation in finance, Bergemann and Hege (2005) and Horner and Samuelson (2013) model a new venture as a bandit. The investor controls the flow of funding allocated to the new project and hence how fast information about the new project arrives. This feature also allows the investor to determine the rewards. Given the fund provided by the investor, the entrepreneur controls the amount of funds allocated to the project, which is unobservable to the investor. A moral hazard problem, therefore, arises.

(3) In corporate finance, several theoretical models propose the optimal compensation scheme to motivate innovation. Manso (2011) incorporates the tension between exploitation and exploration into a principal-agent model to study incentives for innovation. He concludes that a tolerance for failure is required for providing managers an incentive to pursue innovation.

２．研究の目的

This project intends to analyze several incentive issues that may arise during the process of innovation. Departing from the literature of experimentation in teams, where team members are homogeneous, "Hierarchical Experimentation" (Chen and Ishida, 2018) considers a bandit problem faced by a team of two heterogeneous players, a principal and an agent, where the agent focuses strictly on implementing the project, while the principal retains the right to terminate it and may be privately informed about the project quality.

In addition to the case of a hierarchical team, there are other directions for the project to investigate:

(1) Suppose that players who collaborate on a common project hold different views on the profitability of the project. Will a player try to persuade other players into his own belief? If so, what measure will he take? What kind of player will benefit from the process?

(2) Suppose that whether a player can achieve a success depends on not only the quality of the project, but also a player's ability. If a player is not sure about his

own ability, then after a long try without any achievement, a player might either lose confidence in the project, or lose confidence in himself. Under what conditions will either case occur? On the other hand, if a player has private information about his own ability, how will he manipulate his effort supply to affect other players' beliefs and efforts?

(3) Given the scenarios we consider above, we can derive the optimal incentive schemes to maximize the total welfare. However, the complexity of dynamic experimentation models imposes restrictions on characterizing the optimal contract. Therefore, developing a simple and elegant model that exhibits a rich structure at the same time will be the greatest challenge to study the optimal contract.

３．研究の方法

This project was collaborated with Professor Junichiro Ishida at Osaka University. We first pinned down the topics, develop suitable models, derived theorems and propositions, and proved the results. After the main results were derived, we discussed with our colleagues at Institute of Economics Research, Kyoto University and Institute of Social and Economic Research, Osaka University. We also presented the results in seminars and conferences both in Japan and overseas. We incorporated all the comments received and submitted them to journals.

４．研究成果

In the paper "Dynamic Performance Evaluation with Deadlines: The Role of Commitment," we consider a tenure-clock problem in which a principal may set a deadline by which she needs to evaluate an agent's ability and decides whether to promote him or not. We embed this problem in a continuous-time model with both hidden action and hidden information, where the principal must induce the agent to exert effort to facilitate her learning process. The value of commitment to a deadline is examined in this environment, and factors that make the deadline more profitable are identified. Our simple framework allows us to obtain a complete characterization of the equilibrium, both with and without commitment, and provides insight into why up-or-out contracts are prevalent in some industries while they are almost non-existent in others. This paper was published in Journal of Industrial Economics in 2018.

In the paper "Hierarchical Experimentation," We consider a bandit problem faced by a team of two heterogeneous players. The team is hierarchical in that one (the principal) retains the exclusive right to terminate the project while the other (the agent) focuses strictly on implementing the project assigned to him. As a key departure, we assume that the principal may be privately informed about the project quality. In contrast to the existing literature, the belief in our model generally follows a non-monotonic path: while each failure makes the agent less confident in the

project, the uninformed principal drops out gradually over time, which partially restores his confidence. We derive explicit solutions for the agent's effort and the principal's exit decisions, which allow us to obtain a full characterization of the equilibrium. Our analysis elucidates how and under what conditions an organization gets trapped in a stagnant phase where little action takes place. This paper was published in Journal of Economic Theory in 2018.

In the project "A War of Attrition with Experimenting Players", we extend a standard incomplete-information war of attrition to incorporate experimentation and private learning. We obtain a characterization of all equilibria in this extended setup and use this setup to illuminate a tradeoff between short-run and long-run gains of experimentation. The extension adds a new dimension to the problem and yields qualitative impacts on its strategic nature. We in particular show that the option value of experimentation serves as a credible commitment device to stay in the game, which is instrumental in inducing the other player to concede earlier. As a direct consequence, there may be an equilibrium in which the strictly less efficient player can get the better end of the deal, implying that slow learning can be a blessing in this type of competition. This paper is forthcoming in Journal of Industrial Economics.

The paper "An Entry Game with Learning and Market Competition" provides a dynamic game of market entry to better understand the emergence of a market pioneer and its welfare implications. Our model features market competition and private learning about the uncertain market condition, which gives rise to the first-mover and second-mover advantages in a unified framework. We identify a necessary and sufficient condition for the first-mover advantage to dominate, hence resulting in the emergence of a market pioneer. Our model elucidates when and under what conditions a firm becomes a pioneer, an early follower or a late entrant and points to an elusive link between static market competition and dynamic entry competition.

In the project "Reputation Concerns in Risky Experimentation," we develop a general model, with the exponential bandit as a special case, in which high-ability agents are more likely to achieve early success but also learn faster that their project is not promising. These counteracting effects give rise to a signaling model in which the single-crossing condition fails but a double-crossing property holds. We characterize the unique D1 equilibrium under double-crossing condition, and show that it tends to produce pooling. Ability to identify good projects and ability to execute a good project have different implications for the equilibrium allocation. Our model also incorporates public news, which generates dynamic distortions.

５．主な発表論文等

〔雑誌論文〕　計2件（うち査読付論文　1件／うち国際共著　0件／うちオープンアクセス　0件）

１．著者名 Cihia-Hui Chen and Junichiro Ishida	４．巻 177
２．論文標題 Hierarchical Experimentation	５．発行年 2018年
３．雑誌名 Journal of Economic Theory	６．最初と最後の頁 365-404
掲載論文のDOI（デジタルオブジェクト識別子） 10.1016/j.jet.2018.06.006	査読の有無 無
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

１．著者名 Cihia-Hui Chen and Junichiro Ishida	４．巻 印刷中
２．論文標題 Dynamic Performance Evaluation with Deadlines: The Role of Commitment	５．発行年 2018年
３．雑誌名 Journal of Industrial Economics	６．最初と最後の頁 印刷中
掲載論文のDOI（デジタルオブジェクト識別子） なし	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 －

〔学会発表〕　計6件（うち招待講演　4件／うち国際学会　2件）

１．発表者名 Chia-Hui Chen
２．発表標題 An Entry Game with Learning and Market Competition
３．学会等名 18th Annual SAET Conference（国際学会）
４．発表年 2018年

１．発表者名 Chia-Hui Chen
２．発表標題 An Entry Game with Learning and Market Competition
３．学会等名 Hong Kong Baptist University（招待講演）
４．発表年 2018年

１．発表者名
Chia-Hui Chen

２．発表標題
An Entry Game with Learning and Market Competition

３．学会等名
CUHK Workshop on Microeconomic Theory（招待講演）

４．発表年
2018年

１．発表者名
Chia-Hui Chen

２．発表標題
An Entry Game with Learning and Market Competition

３．学会等名
The University of Tokyo（招待講演）

４．発表年
2018年

１．発表者名
Chia-Hui Chen

２．発表標題
An Entry Game with Learning and Market Competition

３．学会等名
Concordia University（招待講演）

４．発表年
2018年

１．発表者名
Chia-Hui Chen

２．発表標題
Hierarchical Experimentation

３．学会等名
AEI Five Joint Conference（国際学会）

４．発表年
2017年

〔図書〕　計0件

〔産業財産権〕

〔その他〕

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６．研究組織

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