Competitive Experimentation with Heterogeneous Learning Modes

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Abstract

We study a continuous-time game of competitive experimentation in the exponential bandit framework. Two firms engage in a winner-takes-all race on two research lines. The first line is ex ante more profitable (in expectation) but risky: a discovery either delivers a positive lump-sum payoff or is a dead end; the return from the second line is certain but smaller. Research activities and dead ends are private information. Breakthroughs are public. We model heterogeneous learning curves within an industry by assuming that the two firms differ in their ability to conduct innovative research: one firm does not learn from its own experimentation unless it observes an outcome; the other continuously revises its belief about the type of the risky line, the direction of the update depending on which outcome arrives with the highest intensity. Shutting down learning from own experimentation for both firms, the model is a version of Akcigit and Liu (2016). Two types of inefficiency arise in equilibrium. A dead-end inefficiency occurs when one firm discovers a dead end and switches silently to the safe line while the opponent does not, generating wasteful research. An information-externality inefficiency occurs when one firm switches too early to the safe line; indeed, without making a discovery or observing a breakthrough from the rival, the firm becomes pessimistic about the profitability of the risky line. Asymmetric learning modes strongly affect the strategic interaction. In equilibrium, firms learn about the type of the risky line from two sources: their own research on the line (active learning), and from not observing a success from their competitor on either line (passive learning). When good outcomes arrive at a higher intensity than dead ends, active and passive learning reinforce each other. Thus, the information-externality inefficiency is exacerbated and both firms abandon too early the risky project. If dead ends arrive at a higher intensity than good outcomes, active and passive learning push in opposite directions. In this case, if dead-ends arrive sufficiently faster than good outcomes, the information-externality inefficiency disappears. In the intermediate cases, both inefficiencies arise, but the information externality is mitigated. Inefficiencies persist even when research activities and dead ends are public. Our results highlight how standard industrial policies (e.g., taxes, R&D subsidies, and IP protection) may have adversarial effects instead of reducing the inefficiencies they target. In addition, we contribute to the theoretical literature on strategic experimentation by analyzing the role of heterogeneous learning modes on equilibrium outcomes.

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