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Optimal entry timing

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Abstract

A player of privately known strength chooses when to enter a market, and an incumbent chooses whether to compete or concede. Information about the potential entrant's type is revealed publicly according to an exogenous news process and the timing of entry. I analyze stationary equilibria using the public belief as a state variable. No equilibria in pure strategies exist, and smooth-pasting conditions need not hold. Under both D1 and a novel refinement, the informed player has nondecreasing value functions and her strategy has the following structure: for high states, both types enter with certainty; for a possibly empty interval of intermediate states, no type enters; and for low states, the high type enters while the low type mixes. I obtain closed form solutions and analyze comparative statics for such equilibria. The welfare effects of the presence of news, relative to no news, depend on the starting belief; however, for a fixed equilibrium, a marginal increase in news quality always helps the informed player regardless of her type and always hurts total welfare.
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1. Introduction

In a wide variety of settings, an agent must choose the optimal time to take an aggressive action against an opponent. The aggressor naturally has private information about her strength, which may be high or low, and her opponent must choose how to respond to the action given his beliefs about the aggressor. If he is confident that the aggressor is weak, he may decide to fight back, knowing that he is likely to win. If instead he believes the aggressor is strong, he may prefer to concede, cutting his losses. Public information about the potential aggressor arrives through a continuous stream of news with noise; that is, both good news and bad news arrive in infinitesimal increments, but the likelihood of good news is correlated with the aggressor's strength. The aggressor's public reputation is influenced both exogenously by this news process and endogenously by the information inferred from the timing of her action. As the optimal response under uncertainty depends on the aggressor's reputation, the aggressor should optimize the timing of her action anticipating the path her reputation might take in the future.

Such games of aggression or "attack" occur in many specific settings. While for expositional purposes I will focus on an economic setting of market entry, it is worth highlighting some other applications of the model.

- A military power or rebel organization decides when to invade a territory in the hope of gaining control or having some demands met. Prior to this decision, exogenous information arrives through central intelligence reports and social media. Its opponent may simply meet these demands, or it can engage in risky physical conflict.
- A politician running for office decides when to launch a harsh negative ad campaign, and its opponent then either quits the race or responds with heightened campaign spending. Or, an activist group may choose when to publicly rally to influence a decision making authority, and the authority responds by changing its stance or not. Information arrives in either case through journalism, social media and polls.
- An injured party may privately threaten a defendant with a lawsuit, and the defendant can try to negotiate out of court or accept a costly legal battle. Information arrives in the form of evidence, legal research, and traditional news outlets insofar as they influence a potential jury pool.

In each of these settings, the aggressor has private information about her strength and can exploit a strong reputation by intimidating an opponent. In this paper, I model such scenarios as a dynamic game of private information in continuous time with an exogenous news process.

Consider a technology firm, firm one, deciding when to enter a market by introducing a highly innovative product. Specifically, this could be a firm that develops an innovative smart phone or a start-up that creates a new way for consumers to rent movies and video games. Its competitor, firm two, is a traditional firm in the same industry. Naturally, firm one has an informational advantage over firm two about the specific features of the innovation and relevant consumer preferences. However, this information is gradually revealed publicly in two ways: an exogenous news process and the fact that firm one has not yet decided to enter. The exogenous news process represents the aggregate information revealed through channels such as financial statements, customer reviews, expert speculation and leaks. Since firm one's entry strategy depends on its private information, firm two also revises its beliefs based on the timing of entry.

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