The Role of Surprise in Dynamic Contests with Multiple Contenders

Chihiro Morooka*†

April 13, 2026

Abstract

In this paper, we develop a model of three-player dynamic contests to study the role of surprise in situations of conflict. The game features an incumbent who initially holds an indivisible asset (prize), and *two* contenders who seek to capture it. In each period, all players simultaneously decide whether to exert a costly effort or not. If at least one contender exerts an effort while the incumbent does not in a given period, the incumbent gets surprised and loses the asset permanently. If the incumbent exerts an effort, she secures the asset regardless of the contenders' actions. When neither exerts an effort, the incumbent retains possession in that period and the game continues.

We analyze two cases in order to examine how the difference of strengths between the contenders affect the outcome of the game. In the first case, one contender is much stronger than the other, whereas in the second case, the two have the same strength. The following results are shown.

(i) When one contender is much stronger than the other contender, we observe that there exists a Subgame Perfect Equilibrium (SPE) in which only the weaker contender exerts an effort with a positive probability whereas the stronger contender refrains from exerting an effort after every history. From this result, we see that there is no benefit of becoming a stronger contender. We also see that there are several SPEs in which the contenders "take turn" to exert an effort (e.g., only one contender exerts an effort in even periods, while the other contender does in odd periods). At the same time, we show that there is no SPE in which both contenders exert efforts at the same period.

(ii) When the contenders' strength is the same, we see that the result depends on the cost of exerting an effort and the players' patience. We show that, when the cost of exerting an effort is relatively low, there exists a "symmetric" SPE in which two contenders exert efforts with the same probability and the incumbent exerts an effort with a positive probability. But we also show that, when the cost is relatively high and players are impatient, there exists a symmetric SPE in which the incumbent does not exert an effort at each period. Therefore, we conclude that there are multiple SPEs with different payoffs to the incumbent, which means that the contenders can manipulate the incumbent's payoff without changing their own payoffs.

(iii) For each class of equilibrium strategies, we calculate the probability that there is a surprise in each period. Comparative statics indicate that whether the likelihood of surprise rises or not with respect to the cost of effort and patience depends on the strategies. Also, whether the likelihood of surprise for a class of strategies is higher or lower than the one for another class possibly depends on the parameters.

JEL Classification Codes: C72; C73.

Keywords: Contests; Surprise; Dynamic games; Comparative statics; Likelihood.

*School of Science and Engineering, Tokyo Denki University, Japan. E-mail: c-morooka@mail.dendai.ac.jp

†The author would like to thank Doron Klunover for his helpful comments.