

Strategic Uncertainty and Professional Chess

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Professional chess provides a unique setting to study strategic decision making of highly trained professionals with high stakes under pressure. The previous literature has used chess to study central predictions of game theory, the impact of psychological states on cognitive performance as well as strategic risk taking. For example, economists observed how strategic risk taking in chess openings varied with the physical attractiveness of the opponent. In this study, we develop a novel measure of strategic risk for each individual move in a chess game. We then use this measure to study the impact of time pressure on strategic risk taking in professional chess. Our measure is based on the strategic interaction of chess players with the complexity or difficulty of the chess board. For this measure, we collected data on approximately 2 million human chess games from high-level games between 1970 and 2021. We evaluated each move in these games with Stockfish (a chess engine) to measure its quality. Subsequently, we trained a residual convolutional neural network to predict the expected quality of a human move in a given position, which yields an estimate of the difficulty or complexity of a given position. Based on this estimate, we propose a novel measure for the strategic risk of a single chess move: For each move, we first calculate the complexity across a range of possible responses by the opponent. We argue that the variance of these complexities captures notions of strategic risk. If the subsequent complexity strongly depends on the opponents' move, a move therefore entails a greater risk compared to when the subsequent complexity is the same regardless of the opponents' action. To relate this strategic risk taking to time pressure, we rely on a key feature of professional chess: time controls. A time control describes the amount of time each player has for the entire duration of the game, which varies across game modes. To identify the effect of time pressure on strategic risk, we rely on a specific tournament with different time controls and an instrumental variable approach to address potential endogeneity concerns. Endogeneity issues could arise if chess players spend more time in risky positions, negatively affecting their future thinking time. Our identification strategy exploits variation in initial thinking time in the knockout-style FIDE World Cups. In case of a draw, tiebreaks in shorter time controls are played, serving as our identifying variation. In these games, we interact the initial time with move dummies to obtain an instrument for the remaining thinking time. Our results show that chess players choose moves of lower strategic risk with less time. This effect is most pronounced with low remaining thinking time. In contrast, results from simple fixed effects regressions

without an instrument show that players choose moves of higher risk with less time. This underlines the existence of a downward bias when failing to account for endogeneity. This suggests that under the higher pressure of little available time, players tend to minimize strategic risk by simplifying future decisions.