Economics Letters 122 (2014) 7–11

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Decision time and steps of reasoning in a competitive market entry game

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HIGHLIGHTS

- I study level-k reasoning and time pressure in a market entry game.
- I also examine these effects in combination with two rank assigning processes.
- Subjects using relatively more steps of reasoning show higher entry rates.
- With randomly assigned ranks, risk preferences and reasoning levels are relevant.
- Individual characteristics are less important in less competitive markets.

ARTICLE INFO

Article history:
Received 22 July 2013
Received in revised form
10 October 2013
Accepted 17 October 2013
Available online 1 November 2013

JEL classification:
C72
C91
D81

Keywords:
Market entry game
Time pressure
Level-k reasoning
Risk
Competitiveness
Experiment

ABSTRACT

Entry decisions in market entry games usually depend on the belief about how many others are entering the market, the belief about the own rank in a real effort task, and subjects' risk preferences. In this paper I am able to replicate these basic results and examine two further dimensions: (i) the level of strategic sophistication, which has a positive impact on entry decisions, and (ii) the impact of time pressure, which has a (partly) negative influence on entry rates. Furthermore, when ranks are determined using a real effort task, differences in entry rates are explainable by higher competitiveness of males. Additionally, I show that individual characteristics are more important for the entry decision in more competitive environments.

1. Introduction

In a recent paper, Madiès et al. (2013) studied the attitudes of junior and senior employees towards strategic uncertainty and competition in a market entry game inspired by Camerer and Lovallo (1999). Typical for market entry games is the presence of several pure asymmetric Nash and also symmetric and asymmetric mixed equilibria, which make coordination difficult. Laboratory and field experiments have shown that subjects rarely play the equilibrium strategies, although repetition and feedback lead to some learning (Erev and Rapoport, 1998; Ochs, 1998; Duffy and Hopkins, 2005; Erev et al., 2010). There furthermore is evidence of higher entry rates (and overconfidence) when ranking (i.e. the determination of entry order) is done by relative ability instead of a random draw (Camerer and Lovallo, 1999; Madiès et al., 2013).

The market entry game I use is close to those employed by Madiès et al. (2013). They run an experiment with three different market capacities, i.e. $c = 2, 4, 6$, meaning that 2, 4, or 6 subjects who enter the market win a positive amount while all further entrants lose a certain negative amount of money. Additionally, two rank determining processes are imposed: random assignment of subjects' rank and a performance dependent rank, where subjects' relative ability is measured in a post-game real effort task. The main advantages of this design is that it does not only allow for studying subjects' behavior under strategic uncertainty, but also for analyzing the explanatory power of one's preferences towards uncertainty, the beliefs about competitiveness of others and own relative abilities.

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0165-1765/$ – see front matter
http://dx.doi.org/10.1016/j.econlet.2013.10.019

In this paper, I investigate (i) how strategic sophistication is related to an entry decision under uncertainty, and (ii) whether time pressure has an effect on subjects' behavior. The first seems to be a natural step to control for reasoning levels in a rather complex environment. For this reason, I use a recently introduced two-player game by Arad and Rubinstein (2012), called the 11–20 money request game, to measure level-k reasoning.[1] The effect of time pressure on economic decision making is addressed in a growing body of literature (see Kocher et al., 2013, for a recent contribution and a brief review of economic literature on the topic). Due to the fact that many important decisions have to be made under severe time pressure, such as last-minute bidding in auctions (Roth and Ockenfels, 2002), bargaining decisions (Sutter et al., 2003), or decisions in financial markets, it is important to understand whether decision behavior changes in stressful and demanding environments.

2. Experimental design

The design for this experiment is close to that introduced by Madiès et al. (2013) and consists of several parts.[2] In the first part of a session, before they play the market entry game, I elicit subjects' non-strategic risk and uncertainty attitudes (see Fox and Tversky, 1995), by having subjects make two sets of 20 decisions, between an increasing certain payoff and extracting a ball from an urn, each (for details see the online supplement, Appendix A). In the first set the numbers of differently colored balls are common knowledge, which allows measuring attitudes towards risk, as indicated by the switching point from the lottery to the certain payoff. In the latter the mixture is unknown, and the difference between the switching points indicates subjects' attitudes towards uncertainty.

In the market entry game (part 2) each player is initially endowed with 10 points to avoid any net losses from the entry decision. The game is played for two sequences of two periods each, one for both market capacities, $c = 2$ and $c = 6$, i.e. a maximum of 2 (respectively 6) players can make a profit by entering the market. Each sequence uses one of two treatments: *Random* and *Performance*.[3] The differences between the treatments are explained in detail in the paragraph below. Participants were randomly teamed up in groups of 10 at the beginning of each of the four periods. Table 1 shows subjects' payoffs depending on market capacity and subject's rank among the entrants. The top c entrants share 60 points, implying that higher-ranked subjects receive higher payoffs. When a player is ranked below the top c, he/she will lose 10 points upon entering, while non-entering subjects do not earn or lose anything. On the decision screen subjects are informed about the sequence, the market capacity, and the amount they win/lose for each rank.[4] They thus have this information before they decide about entering and stating their beliefs about the number of other entrants in their group. This point belief elicitation is incentivized with 5 points for a correct guess.

Table 1
Payoff matrix in the market entry game (in points).

Rank among the entrants	Market capacity	
	$c = 2$	$c = 6$
1	38	18
2	22	14
3	−10	10
4	−10	8
5	−10	6
6	−10	4
7	−10	−10
8	−10	−10
9	−10	−10
10	−10	−10

The differences between the *Random* and the *Performance* treatments concern the rank assignment. In the *Random* treatment, subjects' rank is randomly assigned, while in the *Performance* treatment, subjects are ranked according to their relative performance in a real effort task (part 3) involving correctly positioning sliders on the computer screen (introduced by Gill and Prowse, 2012).[5] In my design, similar to Camerer and Lovallo (1999) and Madiès et al. (2013), subjects completed the slider task after the market entry game, which leads to a situation where subjects hold an a-priori belief about their subsequent relative performance when making the entry decision. The performance is measured by counting the number of correctly positioned sliders within two minutes.[6] The subject with the highest number is assigned the first rank within the group, the subject with the second highest is assigned the second rank, etc.

Making use of the forecast belief about the number of entrants, I determine how players' behavioral adjustment is influenced by their perception of others' competitiveness. The difference in entry decisions between the two treatments provides information about how behavior is influenced by the belief about relative performance. For instance, whenever a player believes his/her relative ability to be better than that of a randomly selected other player, the likelihood of entry should be higher in the *Performance* than in the *Random* treatment (for given capacity and beliefs).

To study the effects of time pressure, which — besides studying strategic sophistication (see the paragraph below) — constitutes the main aspect and innovative dimension of this paper, the market entry game (part 2) of the experiment is played with two different time constraints: in *NOPRESS*, subjects face a time limit of 3 min in every period, which was designed not to introduce any pressure on the entry decision and belief forecasting.[7] In *PRESS*, they are limited to $(17 - t)$ s, where t indicates the period. This decrease of time available over periods is designed to compensate for shorter decision-times in later periods observed in treatment NOPRESS, and guarantees a constantly highly challenging environment.

In part 4 of the experiment, strategic sophistication is measured using a new and straightforward level-k reasoning game named the "11–20 Money Request Game" (Arad and Rubinstein, 2012). This is a two-player simultaneous move game where players request between 11 and 20 points, which they receive for sure. Furthermore, a player who requests exactly one point less than the other receives 20 extra points. See Arad and Rubinstein (2012) for an extensive discussion of the notable features of this easily implementable and appropriate game for studying level-k reasoning.

1 Lindner and Sutter (2013) study (i) the influence of time pressure on level-k reasoning within this game and find behavior (perhaps coincidentally) close to the equilibrium prediction, and (ii) learning in a five-fold repetition of this game, which does not lead to a convergence towards equilibrium play.

2 In particular the market entry game differs in the number of periods (4 instead 18), market capacities (2 instead 3), the feedback subjects receive after each period (none instead of the number of entrants), and the task used to elicit performance. The feedback about all decisions and payoffs participants get is given at the very end of the experiment directly before payment.

3 The order of the sequences and the order of the market capacity within a sequence were random across subjects.

4 It was common knowledge that subjects will learn the sequence, the market capacity, and the points corresponding to the ranks; and also that four periods will be played in random order and only one of them will be paid out randomly. The market entry game was explained with a fictive capacity for both sequences. For more details see the instructions and a screenshot of the decision screen in the online supplement (Appendix A).

5 The code implementing the slider task is based on the code developed by Gill and Prowse (2012), which they kindly provide online.

6 Subjects played two trial periods to get used to the task before the ability-relevant third period. For more details on the task and instructions see the online supplement (Appendix A).

7 All participants in NOPRESS were able to finish the decision and belief forecasting within the 3 min; median decision time in the first period was 21.5 s.