Game Theory and Risk assessment of Companies

1. Introduction

Game theory is the study of multi-person decision problems (Gibbons, 1992). In the business world, it is mainly applied in the analysis of oligopolies from duopoly to multi-person oligopolies (Gibbons, 1992).

1.1. A brief introduction to game theory

The analysis of game theory depends on various common assumptions on the (1) number of players, (2) static (simultaneous movement) or dynamic (alternating movement), (3) complete or incomplete information, (4) the strategies available, (5) discount factor (Osborne, 2004). In the most advanced end of game theory, assumptions on timing of competitive move (time lag of each competitive move, endogenous or exogeneous timing, finite or infinite horizon or adjustment costs can also be assumed in the game theory models (Maskin & Tirole, 1987). Therefore, with a certain level of predictive power, game theory is highly useful in risk management against competitive moves or threats if the game theory model is well-specified under different forms of equilibrium (namely, Nash equilibrium, subgame-perfect Nash equilibrium, Bayesian Nash Equilibrium, perfect Bayesian equilibrium, Markov Perfect Equilibrium, etc (Gibbons, 1991; Maskin & Tirole, 1987). The issue of risk management application in game

3. Analysis of possible competitive movement of Amazon to Walmart based on the assumptions in Section 1.1

This section is divided into the discussion of earlier variant of Cournot model and the Cournot model variant of the latest research.

3.1. Earlier Cournot model

The assumptions listed in Section 1.1 fulfil the criteria for dynamic game with perfect information as discussed by Friedman (1971) and Gibbons (1992).

Before going to directly to the Cournot model by Friedman (1971), the original Cournot model in 1838.

There are two curves showing the q_1 and q_2 to be produced by Firm 1 (Amazon) and Firm 2 (Walmart) respectively. The Nash equilibrium point is the intersection point (q_1^*, q_2^*) which $\frac{a-c}{3}$ where a is the price, c is the cost. The point (q_1^*, q_2^*) is denoted as q_c in future discussion.

However, the Cournot model described by Friedman (1971) assumes an infinitely repeated game, resulting in a different in the original one-stage Cournot model.

First, in the Cournot model, $\mathrm{Q} = q_1 + q_2$ and $\mathrm{P(Q)} = \mathrm{a} - \mathrm{Q}$, assuming $\mathrm{Q} < \mathrm{a}$. Each firm has a marginal cost of c and no fixed costs. The two firms

other academic literature on whether Amazon and Walmart will cooperate under other slightly different assumptions.

Gibbons (1992) documents another form of Cournot model which two assumptions were changed.

- Dynamic >>>> Static;
- Perfect information >>>> Imperfect information or asymmetrical information of cost in the dominant firm i.e. Amazon.

In the static asymmetrical information model, it is assumed that two firms. Firm 1 is an older player i.e. Amazon in the market while Firm 2 is a newer player i.e. Walmart. Because Firm 2 is a newer player, he knows all the cost information of Firm 1 and their own cost information. However, Firm 1 only its cost information but only the probability of higher cost of Firm 2 (denoted as θ) and the higher marginal cost of Firm 2 (denoted as c_H) and also the probability of lower cost of Firm 2 (denoted as 1-θ) and also the lower marginal cost of Firm 2 (denoted as c_L).

Without showing all the calculation, it is found that if firm 2's cost is high, for example, it produces less because its costs is higher but also produces more than needed because Firm 1 knows that firm will produce the maximum quantity to maximise its profits, vice versa. The implication is that

each of the two stages. The result was that (1) Cournot profits is always larger than Bertrand model regardless of whether it is substitutes or complements while Bertrand model is more efficient than Cournot in terms of consumer or total surplus and (2) it is better to choose Cournot contract (i.e. quantity contract) when the goods are substitutes.

In another two similar research studies by Qiu (1997) & Symeonidis (2003), it was found that Cournot competition is superior to Bertrand competition in terms of more cost-reducing and product R&D effort in differentiated duopoly respectively in Qiu (1997) and Symeonidis (2003) and when products are not too differentiated (Symeonidis, 2003).

The assumptions of Qiu (1997) is that (1) there are two players, (2) two stages, (3) static model with simultaneous movement, (4) non-cooperative, (5) cost-reducing R&D and (6) perfect information. The assumption of Symeonidis (2003) is that (1) there are two players, (2) two stages, (3) static model with simultaneous movement, (4) non-cooperative, (5) both product R&D and process R&D or horizontal differentiation and (6) perfect information.