



The Implementation Of Game Theory Models In Transportation

Yuhelson
Universitas Jayabaya Jakarta
yuhels@yahoo.com

Abstract

In most industries a central characteristic of competition is that firm are mutually dependent: firms feel the effects each others' moves and are prone to react to them (Porter, 1980). This situation, economists call an oligopoly. An oligopoly has few sellers, with interdependent pricing decisions among the larger firms iin the industry (Nafziger, 1997). This interdependency is the essence of competition.

INTRODUCTION

STRUCTURE OF GAME THEORY MODELS

A game is characterized by a set of rules which describe (1) the number of firms competing against each other, (2) the set of actions that each firm can take at each point in time, (3) the profits that each firm realizes for each set of competitive actions – do these actions occur simultaneously or does one firm move first? – and (4) the nature of information about competitive activity – who knows what, when? (Sudharshan, 1995).

The following game illustrates the nature of these rules :

EXHIBIT 1 Jakarta – Balikpapan Airline price Game

Price	Rp.600.000,-	Rp.900.000,-
“Nyaman”	Rp.600.000,- Rp.40K. Rp.40K	Rp.65K. Rp.20K
“Aman”	Rp.900.000,- Rp.20K. Rp.20K	Rp.55K. Rp.50K

K x 1,000,000

First entry in each cell refers to “Nyaman” ‘s payoff; the second entry, “Aman” ‘s payoff.

Two airlines, “Aman” Airlines and “Nyaman” Airlines, are the only competitors on the Jakarta - to – Balikpapan route. Each airlines has two actions concerning price – charge Rp. 600.000,- or Rp. 900.000,- per round trip ticket. If both airlines charge Rp. 600.000,-, say they will both make an annual profit of Rp. 40.000.000,-. If they both charge Rp. 900.000,- they will both realize an annual profit of Rp. 50.000.000,-. However, if one firm charge Rp. 600.000,- and other charges Rp. 900.000,- the lower priced firm will earn Rp. 65.000.000,- and the higher priced firm will earn only Rp. 20.000.000,- 9see Exhibit 1.) Both “Aman” and “Nyaman” Airlines have full information about the potential actions and payoffs of their



competitor. Finally, at the beginning of each month, both airlines establish a price simultaneously (without knowing each other's price) and maintain that price for the entire month.

EQUILIBRIUM CONDITIONS

Given the competitive situation described in Exhibit 1, what price will "Aman" and "Nyaman" charge for the Jakarta – Balikpapan route? From a noncooperative game theory perspective, the Nash equilibrium indicates how rational firms will compete in such conditions. This equilibrium is defined as the strategy (sequences of moves) for each firm that will result in neither firm being willing to change its strategy *unilaterally*. (Sudharshan, 1995)

NASH EQUILIBRIUM

In the airline example, clearly both firms are better off if they both establish a fare of Rp. 900.000,-. But if "Aman" thinks that "Nyaman" will charge Rp. 600.000,-, "Aman" will make more profits by pricing at Rp. 600.000,- also. The Rp. 900.000,- price level for each firm is not a Nash equilibrium because, at Rp. 900.000,- each firm has an incentive to unilaterally lower its price to Rp. 600.000,-. However, The Rp. 600.000,- price level is a Nash equilibrium because neither would want to unilaterally raise its price to Rp. 900.000,-.

A simple approach to finding a Nash equilibrium solution for such a two player game is:

1. Construct a payoff table as on Exhibit 1.
2. Take "Nyaman" 's point of view first. Find the price (strategy) that "Nyaman" should choose a price of Rp. 600.000,-. Mark the cell of this choice by a circle.
3. Repeat step 2 for an assumption "Aman" price of Rp. 900.000,-. Again mark the cell of this choice by a circle.
4. Now take "Aman" 's point of view. Find the price that "Aman" should choose assuming that "Nyaman" would choose Rp. 600.000,-. Mark the cell of this choice with a square.
5. Repeat step 4, for an assumption "Nyaman" price of Rp. 900.000,-. Again mark the cell of this choice by a square.
6. To find a Nash equilibrium solution, look for the cell with both a circle and square marking it.

Why to not "Aman and "Nyaman" each assume that their competitor is smart enough to know that cut-throat prices will hurt both of them, and each set a price of Rp. 900.000,- and both make more money? (This example is a form of the classical prisoner's dilemma – both stand to benefit through cooperation, but each has an incentive to deviate from this strategy if unsure of the other, and if the other follows a different strategy.) Without binding agreement (collusion), how can "Nyaman" trust "Aman" not to act in its own self-interest and drop its price to Rp. 600.000,- for a month?

The notion of cooperating could be incorporated in the game by restricting the pricing options to Rp. 900.000,- (as the result of a binding agreement which may be illegal) or adjusting the payoffs to reflect "good judgment." However, the model of this competitive situation does not incorporate these elements.

MULTIPLE EQUILIBRIA

In some models of competitive situations there are multiple equilibria. Consider the following hypothetical ex-sample: "CV. Tri Tunggal" has the only Stevedore's tire equipments in Tanjung Priok. Because of its monopolistic position, say the NPV (Net Present Value) of



“Tri Tunggal” ‘s Indonesia operation is in 160 billion Rupiahs. “Anjangsana” is considering building a plant and entering the market. If “Anjangsana” enters the market, “Tri Tunggal” can either “acquiesce” and share the market or “fight” for market share by reducing prices and increasing advertising. If “Anjangsana” acquiesces, “Tri Tunggal” will realize a NPV of 108 billion Rupiahs and “Tri Tunggal” will realize a NPV of 72 billion Rupiahs.

However, if “Tri Tunggal” fights, the anticipated NPV for “Tri Tunggal” is 72 billion Rupiahs and “Anjangsana” will have 0 NPV. If “Anjangsana” dose not build the plant in Tanjung Priok, it will make a capital investment in an Italian factory that will result in an NPV of 36 billion Rupiahs.

this market entry situations is illustrated in Exhibit 2. In this competitive model, the parties make sequential moves. First, “Anjangsana” Decides to enter or not. Then, “Tri Tunggal” decides to fight or acquiesce.

“Tri Tunggal”
Decision fight

Consequences

Asquiesce

Enter
“Anjangsana”
Decision

Not fight
Enter

Time
0

Acquiesce
Time
1

Time
3

The payoffs indicate that “Anjangsana” should enter, if it is assured that “Tri Tunggal” will not respond vigorously; however, if “Tri Tunggal” ‘s response is to fight, then “Anjangsana” should not enter the Indonesia market. From “Tri Tunggal” ‘s perspective, it would be best if “Anjangsana” did not enter; however, if “Anjangsana” enters, “Tri Tunggal” woul make more profit if it acquiesced rather than responded vigorously.

This game has the following two equilibria:

Equilibrium “Anjangsana” Strategy “Tri Tunggal” Strategy

1. Do not enter Fight, if entry undertaken
2. Enter Acquiesce, if entry made.



Volume : 04
Nomor : 01
Bulan : Januari
Tahun : 2018
<http://ejournal.pps.ung.ac.id/index.php/AKSARA/index>

Clearly, the concept of equilibrium does not provide an answer because there are two possibilities. Each equilibrium favors one of the competitors. However, the second equilibrium seems to be more reasonable. The first equilibrium is supported by a potentially spurious threat “Tri Tunggal” threatens to fight but actually will be motivated to acquiesce if “Anjongsana” enters the Indonesia market. Even though game theorists have devoted considerable effort to evaluating multiple equilibria, the issue of determining a unique solution has not been resolved. (Sudharshan, 1995).

CONCLUION

In an oligopoly firms is partly dependent on the behavior of its rivals, selecting the right competitive move in value finding one whose outcome is quickly determined and also skewed as much as possible toward the firm's own interests. That is, the goal for the firm is to avoid destabilizing and costly warfare, which specifies poor results for all participants, but yet still outperforms other firms.

Thus success can be assured only if the competitors choose to or are influenced to respond in a non-destructive way.

REFERENCES

- Chow, Irene, Neil Holbert, Lane Kelly, Julie Yu, 1997, *Business Strategy, An Asia-Pacific Focus*, Prentice Hall, Singapore.
- Nofziger, Wayne, 1997, *The Economics of Developing Countries*, Third Edition, Prentice Hall, N.J.
- Porter, Michael E., 1980, *Competitive Strategy, Techniques for Analyzing Industries and Competitors*, The Free Press, New York.
- Sudharshan, D., 1995, *Marketing Strategy, Relationships, Offerings, Timing & Resource Allocation*, Prentice Hall, N.J