DYNAMIC PRICE ANDQUANTITY POSTPONEMENT STRATEGIES

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ABSTRACT

This paper studies competition under dynamic price and quantity postponement where product substituability is included. Supplier who operates as market leader and two retailers who act as follower produce two differentiated products according to the same product family. Price postponement is taken into consideration from a motivation to anticipate product variety while quantity postponement to anticipate demand changing. Furthermore their effectiveness to different substitutability degrees is benchmarked according to Bertrand and Cournot Stackelberg game. System dynamic is applied in order to show how different dynamic game strategies effect to profit and product life cycle at several product substitutability degrees. The simulation results are used to answer two research questions (1) how does product substitution degree affects the different game strategy? (2) How does different game dynamic affect the optimal price, quantities and profit? It is shown that Cournot game is superior to highly differentiated product with short product life cycle while Bertrand game for product that shares common platform and longer product life cycle. Moreover the results show that Bertrand game gives stability effect rather than Cournot game. The final part of the paper concludes the results and outlines future research direction is discussed.

Keywords: postponement, System dynamic, Bertrand game, Cournot game, product substitutability

1. INTRODUCTION

For many years, it has been a common policy for manufacturers to produce in large batches to keep production cost and ordering cost low. Unfortunately, the current trend in consumer requirements does not support this idea. Consumers wish to be served according to their own “special needs” and for this reason the variety of products is increasing. Obviously, it makes production lines become busier with frequent setup and down time due to higher product variety. Inline with this idea, a manufacturer needs to make a closer relationship with his opponents in order to keep their market share. Mass customization now has been to be an order qualifier to supply chains.

This paper focuses on decision making related to the use of dynamic system (defined in section 3.1 and 3.2) in the manufacturer facing high variety demand and specifically on the application of the system dynamic in two types of postponement. It takes a starting point in the so-called price and quantity postponement and analyzes their dynamic properties. The general purpose of this paper is to present a novel approach to manage the decision sequence between price and quantity with system dynamics modeling and benchmarking against their profitability. Particularly, it determines the relevance of such sequences to overcome high variety demand and profit taking requirement.

Two types of postponement that we focus on in this paper are referred to price and quantity postponement. The reason behind this is the key work by Miegham and Dada (1999) who compare different types of postponement strategies. Those three different strategies of postponement (capacity, quantity and price) which, when they are used in combination or separately, constitute the six postponement strategies. Furthermore Gilbert and Cvsa (2003) discuss about how to trade off between price and quantity flexibility in order to encourage innovation. Previously, some literatures investigate different postponement types for instances work of Zinn and Bowerzox (1988) who define five types of postponement strategies according to as product and process redesign (Lee, 1996), delay for product differentiation (Alderson, 1950 and Bucklin, 1965) and built-to-order as distribution logistics enabler (Holweg and Miemczyk, 2005). Such research directions give emphasizement to uncertainty reduction by managerial (Miegham and Dada, 1999) or operational decision (Zinn and Bowerzox, 1988).

Effort to compromise both directions is proposed by Gunasekaran and Ngai (2005) who discuss built to order according to economic factors for instance market forces. Market forces are defined as barrier to entry, bargaining power of suppliers and buyers, product substitutability and rivalry among incumbent firms. From this point on discussion will be emphasized on how to design a postponement strategy by considering market forces.

Alptekinoglu and Corbett (2003) propose a competition between customized and mass production. The authors use three stages static game and players move simultaneously. The outcome is optimal strategy for both of mass and customized production. Moreover at the same time Gilbert and Cvsa (2003) propose price and quantity flexibility to encourage innovation. From all above research directions, this paper uses Miegham and Dada postponement types (2003) by using Alptekinoglu and Corbett (2003) competition idea to find effect of innovation to postponement decision (Gilbert and Cvsa (2003) with a special feature on game dynamic consideration.

This paper uses product substitutability in order to represent innovation (Gibbons, 1992). The reason is product substitutability can describe buyer innovation effort to maximize common platform utilization. Furthermore this paper takes supplier as a market leader in order to maximize buyer innovation. On the contrary if buyer is taken as market leader then they will reluctance to give maximum effort. For instance is in price postponement buyer will produce very unique product so it reduces platform value. This situation will force supplier to reduce its price and finally product lead times become longer because of too much customization. Beforehand, mass customization as a corner stone of postponement is explored in order to enhance our motivation to study further.

Mass customization is acknowledges as a response to high variety customer needs. They are right place, time and order (Bourke, 2007). Kotha (1996) has defined mass customization as enabler to overcome high product variety based on “economy of scope”. Previously, Pine (1993) proposed mass customization as a transformation from supply to demand driven. Moreover, a clear conception on mass customization has also explored by Davis (1987) through four analogy of mass customization these are holography, parallel processing, customized chips, customized catalyst and biotechnology. Fralix (2001) supports this idea by application to sewn products by emphasizing on how mass customized product is fabricated by high volume and tailor-mode. Hewlett Packard mass customization (Lee, 1996) exhibits two postponement types. In conclusion mass customization can be represented as moving from supply to demand chain (Pine and Gilmore, 1999).

Moving from supply to demand chains gives competitive advantage to a company. On the other hand this uncertainty forces cooperation between either product families or upstream and downstream supply chain. Some investigations have been embodied for this in order to manage supplier-retailer relationship (Huang et al, 2007). Inventory coordination has also been proposed in order to minimize inventory cost (Snyder et al, 2005). Chan et al (2004) and Sharifi et al (2006) take up this issue by divides into vertical coordination that includes sequential decision from downstream to doenstream or vice versa and horizontal coordination that emphasizes on interfirm coordination. From this point on, coordination is a requirement to overcome demand variety.

Coordination that we focus on in this paper is referred to price and quantity postponement with the capability to produce multiple products with common platform so we have two retailers who utilize modular component. Application of pricing dynamics provides understanding of how the effect of price postponement to supply chain profit. Price and quantity postponement can retain profit at reasonable value because it will be launched as soon as order launched (see Swaminathan and Lee, 2003) and at the same time provides high benefits to a firm by hedging against demand uncertainty because of variety.

The motivation to apply time and form postponement competition within supply chain is to reduce decision uncertainty (Miegham et al, 1999). Furthermore, the same authors use demand uncertainty factor to compare a set of postponement strategies and clearly, the degree to which firms can utilize postponement strategies is determined by the firm's capabilities as well as the marketplace characteristics. Our objective is to offer guidance to multi-product supply chain on the value postponement competition, considering the different game strategies, product substitution degrees and product life cycle from two stackelberg game models, dynamic Cournot and Bertrand Stackelberg games that represent price and quantity postponement respectively.

The effectiveness of the different game strategies has been studied in the context of equal cost function-product firm without product substitution degree (Fujiwara, 2006). Two interesting research questions then arise: (1) how does product substitution degree affects the different game strategy? (2) How does different game dynamic affect the optimal price, quantities and profit? These questions are the focus of this paper.

Specifically, we consider a supply chain that consists of three parties; they are one supplier and two buyer firms who operate in a monopolistic setting. With regards to both postponement types, Cournot model uses linear quantity function while Bertrand applies linear price function. Supply chain needs to make two sets of decisions: production prices and quantities. Leader can postpone his production decisions to a later time when information on market follower is obtained. Furthermore at the final discussion we can observe both of Bertrand and Cournot Stackelberg games simultaneously by comparing their profit, price level and output (quantity).

The following sections first introduce postponement competition (section 2), where it focuses on features of competition application and game theory. Section 3 describes on postponement modeling with dynamic Cournot game (3.1) and Bertrand game (3.2), which is benchmarked according to their profit and response. Section 4 exhibits results and discussion from problem example. Finally Section 5 explores the opportunity for future research.

2. LITERATURE REVIEW

The objective of this section is to give common perception on supply chain strategy and specifically postponement competition application by game theory with additional review on system dynamics. In addition to Pine (1993) definition of mass customization, Davis (1987) drives readers to an argument that supply chain strategy for mass customization should be focused on the entity properties. For instance modularity is intended to components standardization while postponement is subjected to reduce lead times by move point of differentiation closer to delivery point (Lee, 1996). Shortly if entities have wide variety so that modularity should be done in order to reduce process variation. In other side, postponement is delivered while components have slime variety in order to reduce lead times. Furthermore Ernst and Kamrad (2004), Mikkola (2004) and Salvador et al (2004) propose a flexible strategy that is reflected by combination of modularization and postponement.

2.1 Postponement Competition

Zinn and Bowerzox (1988) differs postponements according to product and process redesign point of view (Lee, 1996). On the contrary Miegham and Dada (1999) proposed six postponement types according to three factors they are capacity, price and quantity. In their paper demand is assumed a function of price so that in that case price can control demand. Meanwhile Biller et al (2005) investigate price postponement effect to quantity and flexibility investment decision according to demand elasticity. The first paper considers to fixed quantity and the second emphasizes on flexible quantity. In addition to both papers, Gilbert and Cvsa (2003) add innovation effort to revenue maximization by postpone quantity or price decision. Similarly, another postponement model is dedicated to product substitutability effect to price and quantity postponement (Bish et al, 2007). This paper considers supply flexibility as a tool to overcome demand uncertainty and keep quantity flexibility. All of those suppose demand can be drawn according to certain functions which is emphasize on price/quantity competition and aside other factors such as decoupling point in push-pull strategy. Push pull strategy needs not only demand information but more emphasize on internal efficiency or costs minimization. In conclusion, two research forts envisage postponement from different perspectives these are operations management (Zinn and Bowerzox, 1988) and economic perspective (Miegham and Dada, 1999).

From all above literature review, this paper studies postponement competition according to both of economic perspective as final goal (price and quantity) and supply chain management perspective by develop a cooperation networks among one supplier and two buyers via game theoretic approach. Previously Miegham and Dada (1999) avoid game theory application because Nash equilibrium does not exist whenever demand is stochastic. On the contrary, game theory is applied in this paper because even demand is stochastic but in this case dynamic Stackelberg game solves this problem by using system dynamic in pricing and quantity decision or in other words the effect of quantity fluctuation has been considered by this game. From this now on, some reviews on system dynamic application on postponement will be explored.

2.2 System Dynamics

Research in dynamic system application to postponement is an important issue with regards to industrial dynamics properties (Forrester, 1958; Houlihan, 1987; Christopher and Towill, 2001). Besides, meeting manufacturing performance and satisfy the customer needs is the main issue in postponement (Huang et al, 2003). In the publication, the author exhibits an optimization model to observe how product variety influences postponement point. The authors use Zinn and Bowerzox (1998) postponement model to describe how it is applied under different demand scenario.

Research in industrial dynamics control system has also been conducted by Towil (1996). The author modeled the requirement to achieve effective industrial dynamics of supply chain such as industrial engineering, control engineering, system simulation and business re-eingineering. The author also supports Forrester effect, which causes supply chain demand amplification. The author summarizes models of real supply chains based on system knowledge, people and observation-based sources as inputs to develop representative problem solving. Furthermore, he also guides readers to deploy real world supply chain into dynamics analysis or from conceptual to tactical problem solving. Finally, he also exhibited a direction of improvement performance where lead-time based management is the most improve than other methodology.

Beside above applications, control system has also applied to high product variety. For instance work of Wilkner et al (2007). They used order book in two options. First option is to maintain delivery level stability by flexible production capacity. On the contrary, the second option is maintain production stability by letting demand fluctuation. Order book here will be act as lists of waiting order that has been promised to be fulfilled. This paper did not give distinction between standard modules and customize modules and analysis will be more emphasized on order book application to manage fixed customer order decoupling point (CODP) and its influence to lead time management issues.

Furthermore Holweg et al (2007) propose another approach is used in order to support collaboration concept by describing relationship as two water tanks. They divided them into four types these are traditional supply chain where each party work by themselves policies, demand information is used to improve supplier forecasts, vendor managed replenishment and synchronized supply where both of supplier and manufacturer merge their replenishment decision.

From the review, it can be concluded that previously papers in control application are much more emphasized in supply and demand dynamic overcoming. On the other side Gunasekaran and Ngai (2005) consider market forces as another constituent that is emerging in management of customized product. Recently some investigations by Miegham and Dada (1999), Alptekinoglu and Corbett (2003) explore this area by either game theoretic or stochastic optimization point of view. Furtermore those papers create a new perspective in postponement research area. This paper objective continues previous researches by putting dynamic behavior beside competition property to those postponement types. This is the focus of this paper.

3. METHODOLOGY

In this section, we propose a study of economic impact of adopting postponement to price and capacity. The objective is to derive findings that will allow us to illustrate results for selecting decision sequence between price and capacity. In what follows we provide a simple analytical framework for evaluating different postponement strategies on revenue basis. The advantage of this approach, in addition to providing comparative results, is that it allows for incorporating decision sequence influencing profit. However, in this research, we only regarding to the development a general framework upon which future work can be based. To focus discussion, consider a supplier that sells a modular component to two retailers who operate based on customized product. From this reason, trade off between service level and efficiency is emphasized on how to decide game type between Cournot and Bertrand game according to product standardization degrees and its dynamics. So that what game type to what competition situation (time to market, product substitutability) is the main topic in this research. To gather general understanding for this concept, both postponement concepts will be discussed separately and then general concept will be developed. The following section discusses competition according to Bertrand and Cournot rule.

3.1 Model Description for Cournot Game (Price Postponement)

In this model we consider a Cournot duopoly model with price function for retailers given by

$$P(Q) = a - Q \tag{1}$$

Where $Q = q_1 + q_2$ is product variant 1 and 2 quantity respectively and ideally they should be produce in equal amount.

This game put Cournot dupoly model with the following reasoning. Naturally, price is not a competiveness objective but market share. For this game, both buyers effort to produce common product is undermined. One solution that is usually adopted is product differentiation in order to get larger market so that cooperation between 2 product variants at certain commonality degree is recomended. The following model can be one of solutions for this problem.

Stackelberg model is taken because mostly market leader in this game is modular component supplier and they tend to produce standard product platform in a large batch. It is assumed that between leader and follower can observe their manufacturing performance each other so that this is a dynamic game with perfect information and finally this game decides equilibrium capacity first before price and it will be run under backward induction as follow

Stage 2 Follower decide his capacity according to leader capacity

$$\underset{q_2}{Max}\,\pi = \left(a - q_1 - q_2 - c\right)q_2 \tag{2}$$

By assuming equal costs function and both players try to cooperate by produce products with a certain commonality degree so (2) can be modified according to Cournot duopoly inversion (Spence, 1976) as follow

$$\underset{q_2}{Max}\pi_2 = \left(\frac{a}{1+\gamma} - \frac{1}{1-\gamma^2}q_1 - \frac{\gamma}{1-\gamma^2}q_2 - c\right)(q_2) \qquad (3)$$

Equation (3) describes that total revenue consists of total profit for two followers minus their total costs then the first order condition for (3) is

$$\left(\frac{a}{1+\gamma} - \frac{q_1}{1-\gamma^2} - 2\frac{\gamma.q_2}{1-\gamma^2} - c\right) = 0 \qquad (4)$$

Similarly the FOC for second product variant is

$$\left(\frac{a}{1+\gamma} - \frac{q_2}{1-\gamma^2} - 2\frac{\gamma.q_1}{1-\gamma^2} - c\right) = 0 \qquad (5)$$

We can solve (4) and (5) simultaneously to be

$$q_2 = q_1 = \frac{\left(1-\gamma^2\right)\left(\frac{a.(1-2.\gamma)}{(1+\gamma)} - c.(1-2.\gamma)\right)}{1-4.\gamma^2} \qquad (6)$$

Stage 1 price decision

This game is developed according to Fershtman and Kamien (1987) and Fujiwara (2006) as follow

$$\dot{p}(t) = K\left(\frac{a}{1+\gamma} - \frac{1}{1-\gamma^2}q_1 - \frac{\gamma}{1-\gamma^2}q_2 - p(t)\right); s > 0 \,;\, p(0) = p_0 \qquad (7)$$

In equation (7) K is a speed value of price to go to its optimal value. Equation (7) also eligible to both suppliers (leader and follower) because Cournot duopoly price definition is a function of its constituents quantities they are leader and follower. In other words, both players adopt equal price policy.

By assuming Cournot competition in this game, then price dynamic can be derived by put equal quantity as follow

$$\dot{p}(t) = K\left(\frac{a}{1+\gamma} - \frac{1+\gamma}{1-\gamma^2}q - p(t)\right) \qquad (8)$$

Equantion (8) gives an important insight to management about price dynamics that is caused by quantity decision. This paper uses an analogy of water tank level to describe that phenomena with intuition that price fluctuation pattern due to quantity decision is equal to fluid property for instance if production quantity is increased then price is automatically reduced. The same case in water tank if water outflow is increased then tank level is automatically reduced. In this paper, we proposed a feedback control mechanism to minimize lead-time and overshoot.

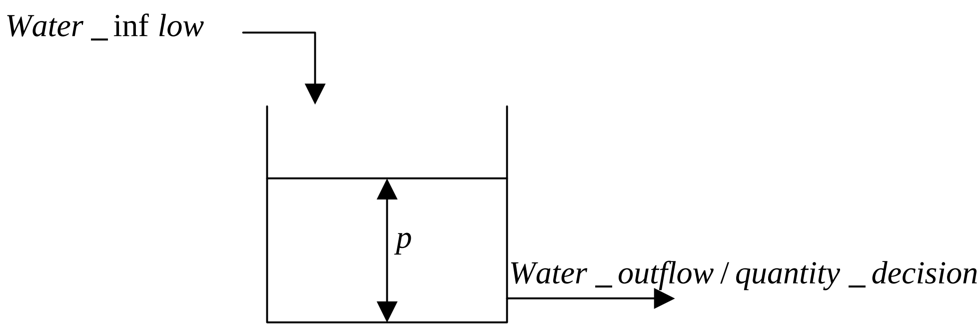

Figure 1 Dynamic price postponement

Figure 2 exhibits dynamic quantity postponement analogy. From this point on we can reconstruct (8) according to

$$\dot{p}(t)+K.p(t)=K\left(\frac{a}{1+\gamma}-\frac{1+\gamma}{1-\gamma^2}q\right) \tag{9}$$

Equation (9) can be reconstructed in order to formulate a transfer function by exclude $K\left(\frac{a}{1+\gamma}\right)$ so that we have the following equation

$$\frac{p(s)}{q(s)}=\frac{-K}{(s+K)(1+\gamma)} \tag{10}$$

Equation (10) represents price postponement transfer function after quantity decision is issued. In addition to accommodate sudden demand changing then $\frac{a.}{(1+\gamma)}$ and a step function can be added into (10) inverse function so that we have

$$p(t)=\frac{a}{1+\gamma}-\left(1+\frac{K}{1+\gamma}.e^{-k.t}\right).q(t) \tag{11}$$

3.2 Model Description for Bertrand Game (Quantity Postponement)

Consider a Bertrand duopoly model with price function for retailers given by (see Gibbon, 2002)

$$Q=a-p_i+\gamma.p_j \tag{12}$$

Where p_i and p_j is time and form postponements prices from both of market leader and follower respectively and ideally they should be produce in equal amount.

This game put Bertrand dupoly model with the following reasoning. Naturally, customization process may want to choose different (and presumably higher) price because of variety. Supplier, on the other hand should take advantage from the above situation by serves inventory in order to reduce selling price and finally either inventory reduction or higher customization price are however risky for customer loose. One solution that is usually adopted is keep steady and optimum production output by considering market fluctuation and competition. The following model can be one of solutions for previous problems.

Stackelberg model is taken because in this case supply is the most dominant problem so supplier as a market leader more comfort with his position as a single supplier. It is also assumed that between leader and follower can observe their manufacturing performance each other so that this is a dynamic game with perfect information. This assumption is adopted because between supplier and retailer employ vertical integration so that both of them can access demand and supply data. In conclusion, this game applies commonality degree in order to attract cooperation between leader and followers.

This game decides equilibrium price first before capacity and it can be described as follow

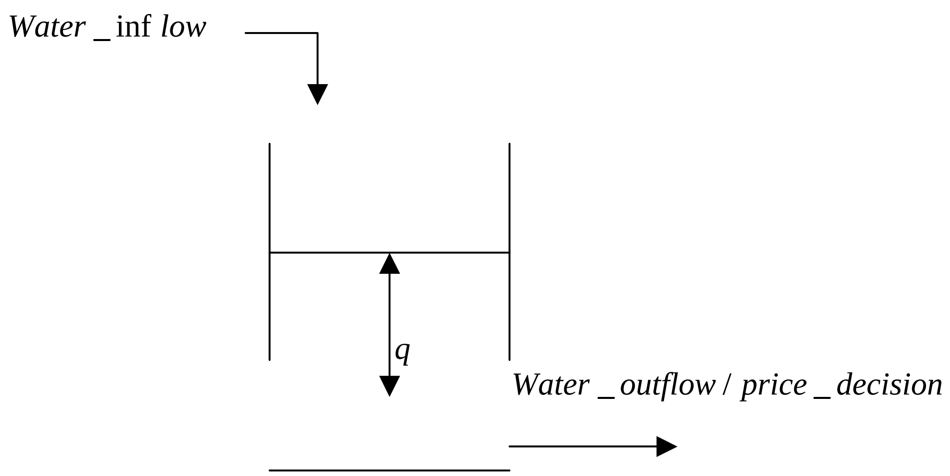

Figure 2 Dynamic quantity postponement

Stage 2 Follower decide his price according to leader price

$$\max_{p1}(a - p_1 + \gamma.p_2)(p_1 - c) \tag{13}$$

The first order condition is

$$a - 2p_1 + \gamma.p_2 + c = 0 \tag{14}$$

Similarly, the FOC from second product variant is

$$a - 2p_2 + \gamma.p_1 + c = 0 \tag{15}$$

Solving these two equations simultaneously, one obtains

$$P_2 = P_1 = \frac{(\gamma + 2)(c + a)}{(4 - \gamma^2)} \tag{16}$$

Stage 2 explores price equilibrium between two buyers. This equation shows effort to maximize standard platform utilization by increasing product substitutability value. Furthermore both buyer and supplier can take advantage from this problem because whenever supplier increases his selling price, buyer product price also increases.

Stage 1 Leader decide his own profit function

At the first stage we can find as

$$\max_{c}\left(a - p_1 + \gamma p_2\right).c \qquad (17)$$

Find c by insert (16) into (17) so we get

$$\max_{c}\left(a + (\gamma - 1)\frac{(\gamma.c + \gamma.a + 2.c + 2.a)}{(4 - \gamma^2)}\right).c \qquad (18)$$

$$c = \frac{(4 + \gamma - 2).a}{(1 - \gamma)(2.\gamma + 4)} \qquad (19)$$

Stage 1 describes that product substitutability influences supplier price considerably. We can see that supplier price is a concave function of product substitutability (γ). Shortly innovation between two buyers increases supplier price also. Finally price decision is used to decide capacity, which is postponement until price is issued.

Capacity decision

Capacity postponement is assumed because Bertrand game players will not try to steal their opponent customer by lower price because their price will simply fall to zero. Moreover they must consider their own capacity and customer demand. Furthermore in economic theory demand is a function for a firm's product (or service) relates the quantities of a product that consumers would like to purchase and it quantities also might be a function of its price (Truett and Truett, 1984).

From this point on, this game is developed according to Fershtman and Kamien (1987) and Fujiwara (2006) but quantity is variable rather than price.

$$\dot{q}(t) = K\left(a - p_1 + \gamma.p_2 - q(t)\right); s > 0\,;\, p(0) = p_0 \qquad (20)$$

In equation (20) we recognize K as speed of quantity to go to its optimal value or we can call it as quantity flexibility and it is eligible to both followers according to Bertrand duopoly quantity function. Because we assume that both followers have same costs function then both players must have equal price so that (11) can be reformulated as

$$\dot{q}(t) - K.q(t) = K\left(a - (1-\gamma)p\right) \tag{21}$$

Equation (21) can be reconstructed in order to formulate a transfer function by exclude $K(a)$ so that we have the following equation

$$\frac{q(s)}{p(s)} = \frac{-K.(1-\gamma)}{(s+K)} \tag{22}$$

Equation (22) represents quantity postponement transfer function after pricing decision is issued. In addition to accommodate sudden demand changing then $K.a$ and a step function can be added into (22) inverse function so that we have

$$q(t) = Ka - \left(1 + \frac{K}{1-\gamma}.e^{-k.t}\right).p(t) \tag{23}$$

4. RESULTS AND DISCUSSION

Previous section discusses about how to compare price and quantity postponement dynamics by using water tank analogy. It is much different with previous approaches by using Hamiltonian function (Fujiwara, 2006; Fershtman et al, 1987) in order to find optimum price and quantity with an assumption that either price or quantity is setup at its optimum value or in other words they are managed by non-stochastic demand assumption. This result is used to show dynamic properties of time and quantity postponement that is caused by demand magnification/reduction. Moreover both postponement strategies are also treated by different solutions, Cournot and Bertrand game. One important feature of this modeling is we can observe system response and profit directly and this is impossible to be done in previous researches.

Firstly, we intend to compare between price and quantity postponement dynamic behavior according to data below

Table 1 Price and quantity postponement simulation data

Price postponement				Quantity postponement			
a	γ	K	q	a	γ	K	p
100	0,1 - 0,3	1	10	100	0,1 - 0,3	1	10

Table 1 is used to direct our simulation in order to compare their effectivity as follow

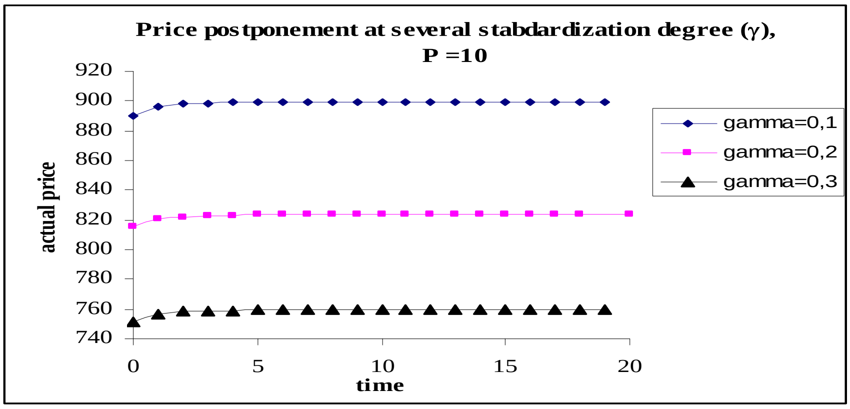

Figure 1 Price postponement dynamics

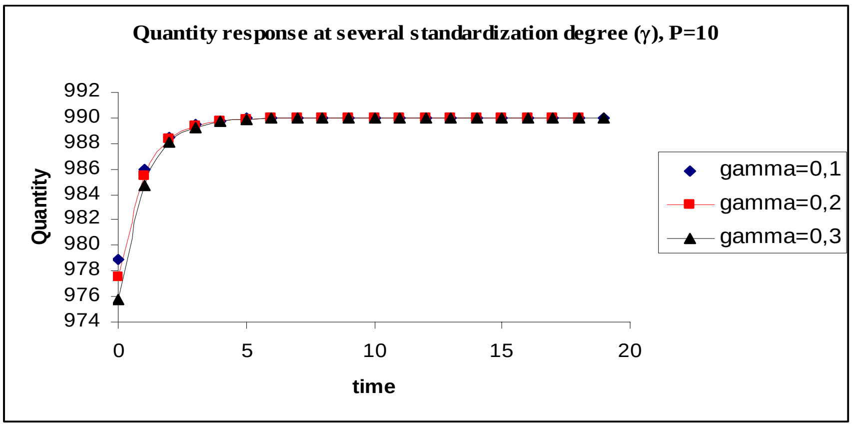

Figure 2 Quantity postponement dynamics

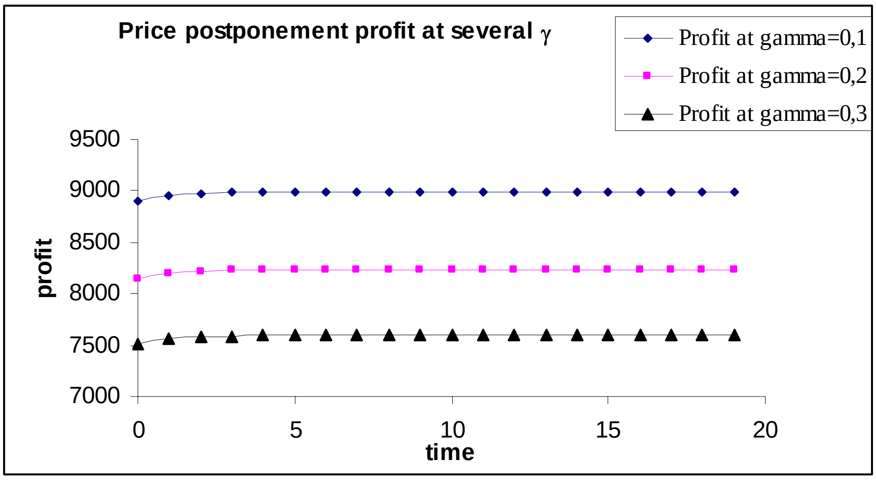

Figure 3 Price postponement profit behavior

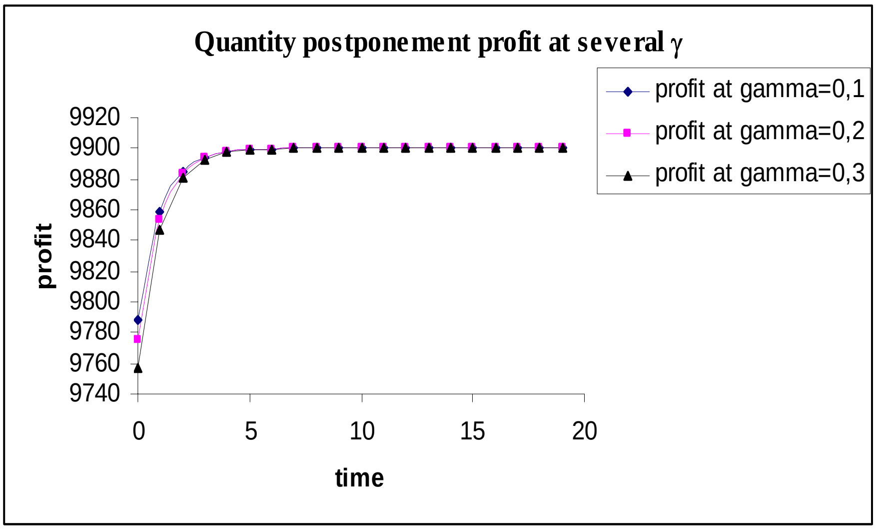

Figure 4 Quantity postponement profit behavior

Those figures will be used to answer our previous research questions as follow

Question 1: how does product substitution degree affects the different game strategy?

Analysis

Figure 1 and 2 exhibits comparison between Cournot versus Bertrand game from quantity and price postponement point of view at various substitutability degrees. Generally, it is shown that product substitutability degree gives considerable effect to Cournot rather than Bertrand game. Moreover Cournot game is better in highly differentiated products and on the contrary Bertrand game gives no difference at any product substitutability degrees. Furthermore Bertrand game gives higher profit to retailers than Cournot game. In conclusion, product substitutability gives significant impact to Cournot game whenever supplier is not a part of supply chain or common platform does not exist.

Conclusion

Product substitution degree gives different significant impact to both of Cournot and Bertrand game. Figure 1 and 2 depict lower substitutability gives advantage to Cournot and on the contrary this effect is not detected in Bertrand game. Cournot game can be explained as if customer has more options for product variant then they will deal with a product based on product configuration. Price postponement had better to be applied at highly differentiated products because they split market sharply according to each product unique features. Different case if product variants does not exist then consumer’s decision will depend on product availability so that producer bargaining position will decrease and finally producer should postpone his production quantity until he receives exact demand information because market is differentiated just according to product availability.

Question 2: How does different game dynamic affect the optimal response of price and quantities?

Analysis

Question 2 is figured out through profit at several product substitutability degrees while Cournot game gives the reverse effect as it depicted by figures 1 and 3. Furthermore figure1 exhibits Cournot game gives faster response than Bertrand game to price and quantities optimization. In short, both games should be applied according to company policy. Product wich is designed for short product life cycle should follow Cournot game while for long product life cycle should adopt Bertrand game.

Conclusion

Cournot and Bertrand game give reverse effect to aggregate profit. Figure 3 and 4 depicts how we should apply both games according to our product design in order to achieve optimal profit. Bertrand game gives more advantage to the entire supply chain because it gives more profit than Cournot game. On the contrary Cournot game gives profit taking acceleration. This situation can be explained as Cournot game traditionally is a quantity competition so retailers will order as much as possible in order to dominate market share and as a consequence of this situation is product introduction phase will be very short. On the contrary Bertrand game is a price competition so retailers will decide their order according to price equilibrium even they cannot flood market with their products. In conclusion, Cournot game is better to be applied to unique product that is produced for special customer so that it does not need product introduction phase while Bertrand game is intended to common product which is designed to longer product life cycle.

5. FURTHER RESEARCH AND CONCLUSION

This paper proposes an alternative method to apply Bertrand and Cournot game to quantity and price postponement according to profit maximization. Both postponement types are explored in order to investigate their compatibility to product substitutability and time to market. This paper proposes dynamic behavior of Bertrand and Cournot Stackelberg games in order to investigate their applicability.

It is shown that the generic model derived is consistent with research questions and important from academic perspective as it utilizes a generic model of multistage price and quantity postponement competition. Particularly, this paper offers a comprehensive solution of both types of postponement according to Dynamic Stackelberg game. Even this paper just proposes a theoretical modeling it is also possible to apply at real situation because this paper accommodates common demand function as it is widely used in economic theory. Furthermore there is a great chance to improve it by moving from duopoly to opligopoly competition where there are more than two monopolists.

For management implication point of view, this paper gives an insight about postponement effect to both of system response and product life cycle. Example for Dynamic Bertrand game is join production between Cakra Kembar and Kereta Kencana wheat flour for some markets. Both products are manufactured by Bogasari Flour Mills Surabaya Indonesia, which is the biggest wheat flourmill in the world. Both products share common wheat grain contents. Kereta Kencana and Cakra Kembar share their market in order to keep their price stability and their product lifetime so in this case they are managed as Bertrand game. On the contrary, Semar plus, which is produced by Bogasari Surabaya, fights with Pena Emas that is produced by Sriboga Ratu Raya Semarang according to Cournot game. This strategy is adopted because both players intend to fight for the same special customer of exclusive bread. Both products have much different product features and produce as much as possible wheat flour to market even they must suffere from price reduction. In conclusion if coopetition (join competition and cooperation) is a marketing strategy then Bertrand game is preferred to Cournot game, on the contrary Cournot game is better to be applied to full competition.

For future research direction, oligopoly model is considered to be developed according to future market demand that is determined by how close customer requirements is meet so that in future oligopoly model quantity and price can be replaced with some parameter such as inventory and lead times. From this result, a sequence between lead times and inventory can be determined and the outcome will be a decision which one more important for a company, agility or efficiency so that the outcome can be used by top management to compose their business strategy. Finally, the future research should accommodate strategic and tactical level alligment in order to develop comprehensive decision analysis.

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