ANALYSIS OF THE USE OF ACCOUNTING PRODUCT COSTS IN OLIGOPOLISTIC PRICING DECISION

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ABSTRAKSI

Makalah ini menganalisis masalah proses penentuan harga oleh manajer dalam pasar oligopolistik. Literatur ekonomi memberikan pendekatan penentuan harga berdasarkan analisis terhadap biaya marginal dan penghasilan marginal (marginal cost and marginal revenue analysis), sementara bukti empirik menunjukkan bahwa manajer cenderung menggunakan pendekatan akuntansi (Govindarajan dan Anthony 1980), i.e., biaya variabel dan biaya penuh (variabel dan full costing). Analisis terhadap informasi sebagai proksi untuk marginal cost dalam proses heuristic penentuan harga.

Makalah ini mengembangkan analisis mengenai penggunaan informasi biaya produksi akuntansi telah diteliti dalam struktur pasar monopoli (Lere 1983 dan 1986), dan struktur pasar oligopoli (Dorward 1986). Perbedaan makalah ini dengan makalah Dorward adalah bahwa makalah ini menganalisis proses penentuan harga dengan menggunakan Bertrand's model, sementara Dorward menggunakan Cournout's model

Hasil analisis makalah ini menunjukkan bahwa Bertrand's model memberikan hasil yang sama dengan Cournot's model, tetapi Bertrand's model lebih menunjukkan kompleksitas proses penentuan harga dalam dalam pasar oligopoli yang lebih tinggi dibanding dengan proses penentuan harga pada pasar monopoli. Dalam pasar oligopoli manajer tidak cukup hanya memperhatikan fungsi perntintaan dan biayanya sendiri tetapi harus juga memperhatikan fungsi permintaan dan biaya kompetitor, dan aksi dan reaksi kompetitor.

INTRODUCTION

In pricing decision, two types of cost information are available in the literature: economics and accounting based cost information. Economics suggests that managers should use marginal cost and marginal revenue information for deciding optimal price and output level, while accounting literature provides full (absorption) and variable (product) cost information. Which information is actually used by managers is an empirical question.

Govindarajan and Anthony (1980), in a survey to the U.S. managers found, consistent with that of Skinner (1970), that it was accounting information that was used by the U.S. managers for pricing decision, not economics based information. This is surprising because the economics approach for pricing decision has been established and apparent in managerial economics and microeconomics literature.

While Skinner's (1970) and Govindarajan and Anthony's (1980) studies were exploratory, further empirical studies indicated relatively consistent results on the internal validity of the theory.While Tichlias and Chalos[1] (1988) study using an experiment involving accounting students in the U.K. support the theory, Hilton, Swierenga, and Turner (1988) using the same method in the U.S. found partial supports for the theory[11]. The studies suggest that under uncertainty and costly marginal cost information, managers use accounting product costs to approach optimal price and output level. Further, Dickhout and Lere (1983), Lere (1986), and Dorward (1986) showed theoretically that in certain settings and heuristic process the accounting product costs can be used to approach the optimal price and output level.

Except for Dorward's (1986) all of the studies explaining the use of product costs for pricing decision reviewed above assumed a monopolistic market structure. Dorward analytically explained the use of product costs under oligopolistic market structure using Cournot's model of Nash equilibrium.

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[1] ln detail, the two studies are different in that the former study didn't consider uncertainties in demand and cost functions and risk preference of the decision makers.

This paper extends the theoretical analysis of the use of product cost in two respects. First, similar to Dorward's, this study assumes an oligopolistic market that involves competition among the firms. Second, this study uses Nash-equilibrium using Bertrand's model instead of Cornout's model applied by Dorward. The effects of using accounting product cost will be discussed based on the refutable assumptions embedded in the analysis of the Nash equilibrium price.

The analysis of the use of accounting product costs by oligopolistic firms under Bertrand's equilibrium reveal similar result with that of Cournot's equilibrium.ln addition the analysis indicates that oligopolistic firm have reveals more complex problem than that of monopolistic firms. While monopolistic firms consider only their own cost functions and demand functions, the oligopolistic firms should consider the actions and reactions of the competitors in addition to the consumers' utility preference and the firms' cost functions.

The rests of the paper are organized as follow. The next section discusses the theoretical analysis on the price and output level decision under monopoly. Section three analyzes the price and output level decision under oligopoly and the use of accounting product costs, and the last section provides the conclusion.

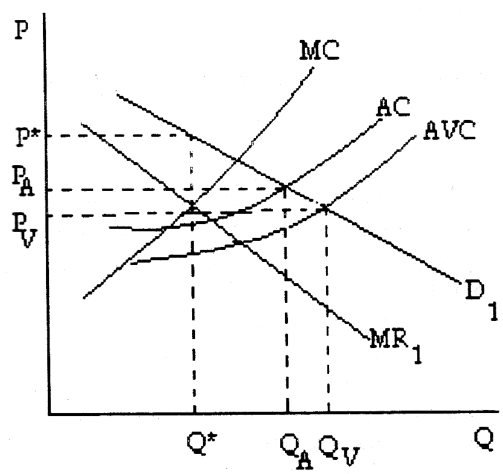
PRICE AND OUTPUT LEVEL DECISION UNDER MONOPOLY

Dickhout and Lere (1983), Lere (1986), and Tichlias (1988) found that the extent to which the absorption cost and variable cost can be used to approach optimal price and quantity decision depends upon the price elasticity of demand function and the condition whether the cost function is increasing or decreasing. Under incomplete production cost information, absorption (variable) product cost is a better approximate to marginal cost when the average total costs are increasing (decreasing), and the more elastic demand curve faced by the firm enhances the deviation[2]. As illustrated in figure l, Optimal price and quantity

[2] Mathematically, these relationships can be explained by substituting the marginal cost [g'(x)w2] by average total cost [(g(x)w2+wivi)/x)] or average variable cost [g(x)w2/2] in the first order condition (FOC) of profit maximization, so that the FOC's are: $Px'(P)+ x(P) - ((g(x)w_2+w_{lV}i)/x)x'(P)=0$ ==> If full cost is used. $Px'(P)+ x(P) - (g(x)w2/2)x^{l}(P) = 0$ ==> If variable cost is used.

decision under complete information (where marginal cost equal to marginal revenue) is Q* and P*. The use of absorption costing result in quantity and price Q_a and P_a, which are closer to the optimal quantity and Price Q* and P* than that of the use of variable costing that results in Q_v and P_v. The more elastic demand curve D' results in the greater deviation between the Q_a and P_a Qv and Pv with Q*

Figure 1 : Accounting product cost as surrogates for marginal cost.



On the contrary, when the cost is decreasing, the condition that happens when the output level is less than that of minimum total average cost, the average total cost per unit is greater than the marginal cost. In this condition, the fixed cost per unit added to average variable cost make the quantity and price decided based on full cost deviates greater to optimal condition than that of average variable cost. Thus, the variable cost per unit is a better proxy to the marginal cost when the cost is decreasing, and a less elastii demand will result in a better approximation.

Based on those analysis Dickout and Lere (1983) and Lere (1986) predicts that decision makers under incomplete information can approach the economic optimal condition by using the accounting product costs and certain heuristic and simple-calculations.

PRICE AND OUTPUT LEVEL DECISION UNDER OLIGOPOLY

The analysis of pricing decision between monopolistic and oligopolistic firm is very different in that while in monopoly the pricing decision analysis corresponds to output level decision, in oligopoly the provided models separate between that focus on price (Bertrand's model) and that focus on quantity (Cournot's model).

Dorward (1986), based on the Cournot's model, theoretically explains that full cost (proportional) pricing will be the most profitable pricing strategy under collusive (non-collusive) oligopolistic situation. Since Cournot's model is not always the best predictor of the competition and is criticized for its naivety (Friedman, 1983), this paper will analyze the pricing strategy in non-cooperative oligopoly using the other model i.e. Bertrand's model.

Nash equilibrium pricing strategies developed based on individuals utility function by Choi et al. (1990) will be used here to identify the firms' pricing strategy in competition. For analyzing price competition, one dimensional duopoly market will be used to derive the comparative static. Profit function of the firms are analyzed based on the derived demand based on the consumer preference model using multidimensional scaling (MDS). It is assumed that each firm produces a single brand with constant marginal cost (so that marginal cost equal to average cost), and there is a finite maximum quality q that a product can achieve. Let the pj and qj denote the price and quality of brand j respectively, a vector (pj,q,) defines brand j. For Uj denote a consumer's utility derived from the purchased of brand j:

$$U_j = V(q_j) - wp_j + \varepsilon , \; j = 1,2 \quad (1.1)$$

where w is a scaling parameter for price which is positive, andV(qi) is a value of a product with quality j such that,

$$V(q_j) = RP - v|q-q_j|_k, \qquad (1,2)$$

Where RP is reservation price, v is the weight for the quality dimension, and I q-q, | k is appropriate distance metric (with k=2 for MDS). For specification of the demand function which based on the individual demand level, the disaggregate choice models are used to incorporate individual heterogeneity, and logit model is used. Let Pr, denotes the probability that a consumer will choose brand j:

$$pr = \frac{\exp\{\Omega U_j\}}{\Sigma_{m=1} \exp\{\Omega U_m\}}, j=1,2 \quad (1,3)$$

Where Ω is a parameter inversely related to ε, and will be estimated by using the predetermined utility function. The total demand of a brand is a sum of individual consumer probabilities; so the profit of firm jth is:

$$\pi_j(p_j, q_j, p_k, q_k)$$
$$=(p_j - C_j(q_j)).Q.Pr_j(p_j, q_j, p_k, q_k), \quad (1,4)$$

for j, k = 1,2 and j ≠ k, Q is the market size C (q_1) is unit cost to produce a brand of quality level q_j, and C_j (q_j) os assumed to be a nondecreasing function.

Based on the profit function (1,4), Nash equilibrium of the price competition can be developed as that $p^{ne} = (p_1^{ne}, p_2^{ne})$ is a Nash equibibrium (NPE) if,

$$\pi_1 = (p_1^{ne}, p_2^{ne}) >= \pi_1 (p_1, p_2^{ne}), Ap_1 \in P1 \subseteq R \quad (1.5)$$

$$\pi_2 = (p_1^{ne}, p_2^{ne}) >= \pi_2 (p_1^{ne}, p_2), Ap_2 \in P_2 \subseteq R$$

In Nash equilibrium no one firm can benefit by changing its strategy. In the situation with fixed quality, NPE is a price vector (pr, p:*) which simultaneously maximizes *n*, and defined in equation 1.4.

Equation (1.3) indicates that every consumer should chose one brand regardless of the price, because there is no price elasticity in the function. To get more meaningful analysis, it is important to incorporate price elasticity of demand in the total demand defined in equation (1.3) by including "no purchase" option in the equation, so that:

$$Pr_j = \frac{\exp\{\Omega U_j\}}{\Sigma_{m=1} \exp\{\Omega U_m\} + 1}, j = 1,2 \quad (1.6)$$

After including purchase option, the equation means that the firms can not charge too high price. But from equation 1.4, the first order condition can be derived for profit maximization:

$$\frac{\delta\pi}{\delta p_j} = Q[Pr_j + (p_j - C_j)\frac{\delta P_{rj}}{\delta p_j}] = 0,$$

devided by Q, and rearranging the term results in:

$$(p_j - C_j) = - \frac{Pr_j}{\delta P_{rj}/\delta p_j}. \quad (1.7)$$

As from (1.1) and (1.6), and pseudoconcavity of TC^ , $8p_{rj}/5p_1 < 0$ because w >0. Also, $P_n > 0$ because of the property of logit function, so the RHS of (1.7) is positive, and p, > C,, that means that the firm can't do no worse than zero profit, and the prices are naturally bounded below by marginal cost.

When Ω, is pseudoconcave with respect to PJ for j=l,2[3]; then under the logit model (1.6), a NPE exist only in the interval Q(<lj) < Pi < f^or both firm j = 1,2^s. A sufficient condition for the existence of Nash equilibrium is then:

$$w <= \frac{1}{\Omega(p_j - C_j(q_j))}, j=1,2, \quad (1.8)$$

For p_j : consider the limiting profits as the price goes to infinity;

$$\lim(p_j - cj).Q.Pr_j = Q\lim\frac{(p_j - cj)}{(Pr_j)^1} \quad (1.1.1)$$

[3] Proofs :

Applying L 'Hospital's rule results in :

$$\lim[xw(\frac{1}{Pr_j} - 1)] \quad (1.1.2)$$

(1.1.2) is zero because Pr, is zero, implies zero profit at the infinite prices, and the equilibrium prices are bounded from above. where pj is some reasonable upper bound of p_j[4]. This means that a Nash equilibrium is more likely to exist as consumers are less sensitive to price changes (smaller w) and their choices are more probabilistic (less fl) . If the consumers are highly price sensitive so that the effect of price difference exceeds that of brand differences, firms will keep undercutting the other's price for a larger share. The undercutting process induces discontinuity in the demand functions, and (as a result of Bertrand's competition), makes the higher cost producers go out of business and the lowest cost producer becomes monopolist.

$$\frac{\delta Pr_j}{\delta p_j}[2-\Omega w(p_j-C_j)(1+2Pr_j)]<=0. (1.1.1)$$

From(1.1)and(1.6) $\delta Pr_j/\delta p_j<=0$ (1.1.2)
Then

$\Omega w(p_j - C_j)(1-2Pr_j) <= 2$, which becomes

$$w(1 - 2Pr_j) <= \frac{2}{\Omega(p_j - C_j)}. (1.1.3)$$

Since the RHS of (1.1,3) is always positive when $pr_j >= ½$ the condition is always satisfied. When $pr_j < ½$ since $(1-2pr_j) <= 1$, the following condition guarantees (1.1.3) holds :

[4] This reflects the existence of NEP for the model through a concavity condition. The proof is as follows:

$$w <= \frac{1}{\Omega(p_j - C_j)}, \text{which is equation(1.7)}$$

since $p_j <= p_j$, for $j=1,2,$

Nash equilibrium under condition (1.8) is the solution of the following system :

$$\frac{\delta\pi}{\delta p_1} = Q[Pr1 - \Omega w(p_1 - C_1)(P_{r1})(1-P_1)] = 0,$$

$$(1.9)$$

$$\frac{\delta\pi}{\delta p_2} = Q[Pr2 - \Omega w(p_2 - C_2)(P_{r2})(1-P_2)] = 0,$$

Since Q is positive constant and Prj > 0, and j = 1,2 (a property of discrete choice functions including the logit model with finite prices), equation (1.9) can be reduced as:

$$(p_1 - C_1)(1 - P_1) - 1/(\Omega w) = 0, \text{ and}$$
$$(p_2 - C_2)(1 - P2) - 1/(\Omega w) = 0 \quad (1.10)$$

The equation (1-10) is very complicated problem to solve due to logit function. However, some limited comparative static can be derived using parametric analysis. Because the two equations are symmetry, only one equation that represent one firm will be analyzed. Let © represents the parameters V., C,, H, and w, and fi and f2 is the two functions of (1.10);

$$f_1(p_1, p_2, \Theta) = 0 \text{ and } f_2(p_1, p_2, \Theta) = 0 \quad (1.11)$$

The total differentiation of (1.11) result in :

$$\frac{\delta f_1}{\delta p_1}\frac{\delta p_1}{\delta\Theta} + \frac{\delta f_1}{\delta p_2}\frac{\delta p_1}{\delta\Theta} + \frac{\delta f_1}{\delta\Theta} = 0$$

$$\frac{\delta f2}{\delta p_1}\frac{\delta p_1}{\delta\Theta} + \frac{\delta f_2}{\delta p_2}\frac{\delta p_2}{\delta\Theta} + \frac{\delta f_2}{\delta\Theta} = 0 \quad (1.12)$$

Equations (1.12) is solved for $\delta p_1 / \delta\Theta$ and $\delta p_2 / \delta\Theta$, result in :

$$\begin{bmatrix} \dfrac{\delta p_1}{\delta\Theta} \\[2ex] \dfrac{\delta p_2}{\delta\Theta} \end{bmatrix} = \begin{bmatrix} \dfrac{\delta f1}{\delta p_1} & \dfrac{\delta f_1}{\delta p_2} \\[2ex] \dfrac{\delta f_2}{\delta p_1} & \dfrac{\delta f_2}{\delta p_2} \end{bmatrix}^{-1} \begin{bmatrix} \dfrac{\delta f1}{\delta\Theta} \\[2ex] \dfrac{\delta f_2}{\delta\Theta} \end{bmatrix} \qquad (1.1$$

Based on the solution of (1.13), the effects of various parameters on the equilibrium price related with cost can be identified, with C'j denotes the first derivative of the cost function of brand j with respect to Vj, as follows:

$$\frac{\delta p_1}{\delta V_1} = \frac{(p_1 + C'_1)e^{U1} + C'_1(wp_2 + 1)e^{U2}}{(wp_1 + 1)e^{U1} + (wp_2 + 1)e^{U2}} \qquad (1.14)$$

$$\frac{\delta p_2}{\delta V_1} = \frac{p_2(wC'_1 - 1)e^{U2}}{(wp_1 + 1)e^{U1} + (wp_2 + 1)e^{U2}} \qquad (1.15)$$

$$\frac{\delta p_1}{\delta C_1} = \frac{e^{U1} + e^{U2}}{(wp_1 + 1)e^{U1} + (wp_2 + 1)e^{U2}} + \frac{\delta p_2}{\delta C_1} \qquad (1.16)$$

$$\frac{\delta p2}{\delta C_1} = \frac{wp_2 e^{U2}}{(wp_1 + 1)e^{U1} + (wp_2 + 1)e^{U2}} \qquad (1.17)$$

If $C_j >= 0$, or higher cost results in higher quality, equation (1.15) is positive, so that the higher cost results in higher quality and price; but equation (1.15) is indeterminant. The change in brand-2's price depends on firm-l's cost and price sensitivity of the consumers. If pi increases significantly, p2 will also increase. But if pi I increases slightly with increase in quality, the firm-2 decreases p2 to regain the lost market share. Both equation (1.16) and (1.17) have positive sign, but the latter is an additive term to the former. This means that I a cost reduction by a firm results in its price reduction, and this also forces the other competing firm's price to decrease. Consequently the profit of firm 2 decreases as the product cost of firm 1 decreases, as represented by the positive sign of

$$\delta\pi/\delta C_1 \quad = \delta\pi_2/\delta p_1 \delta p_1/\delta C_1 + \delta\pi_2/\delta p2 \quad \delta p_2/\delta C_1$$

where the second term vanishes in equilibrium, and the first term is positive. However, the effect of cost reduction to its own profit is less obvious because of the opposite effects of the reduced cost and price levels.

From the discussion above, the use of ac-counting product costs can be predicted. In non-cooperative oligopolistic situation and the price sensitivity of the consumers is high, variable cost is a better basis for the decision makers to determine the price, because the firms in the industry compete by undercutting their price. As indicated in equation (1.7) the price is bounded by marginal cost, or average variable cost in case the marginal cost information is not available.

The use of full cost in this situation may result in the price is too high and the firm loses its market share. In the situation when the price sensitivity is low the full cost is a better basis for price decision for the firms to gain the profit, since the slightly increase in price with higher quality product will at least maintain the market share. These prediction is similar with those of Dorward (1986) that under non-collusive (collusive) oligopoly and Cournot's equilibrium proportional (full) cost based pricing is more efficient.

CONCLUSION AND IMPLICATION

The analysis of the use of accounting product costs by oligopolistic firms under Bertrand's equilibrium reveal similar result with that of Cournot's equilibrium, however the Bertrands model provide more information than Cournot's model in that Bertrand's model indicates that doing in oligopolistic market has more complex problems than that of monopolistic firms. While monopolistic firms consider only their own cost functions and demand functions, the oligopolistic firms should consider the actions and reactions of the competitors in addition to the consumers' utility preference and the firms' cost functions. This complexity indicates more comprehensive heuristic process in pricing and quantity decision than that of illustrated by Dickhout and Lere (1983) and Lore (1986).

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