Pricing of Product Quality and Inequity Aversion: An Envious Perspective

Kangsik Choi *
Pusan National University, GSIS

Abstract: Main findings were obtained regarding the optimal pricing of product quality model, (1) the no-distortion-at-the-top rule is violated when envy is related to the payment differential; and (2) at the optimum, when consumers comparing their rents, the high valuation consumers do not suffer from distortions while low valuation consumers generally do so.

keyword: Inequity Aversion, Pricing of Product Quality, Tradeoff

1. Introduction

Based on the recent experimental results (Camerer 2003; Camerer et al.2004; Gintis et al. 2005), this study intends to present a behavioral contract theory of an adverse selection model focused on both vertical differentiation and price discrimination (hereafter we call this "pricing of product quality") issues that have not yet been examined. To explain such an incentive issue, we will analyze that psychology and economic literature which belong to the monopoly pricing of product quality when consumers care about social preferences.

A growing literature on the behavioral economics of industrial organization deals with interaction of individuals and firms (DellaVigna and Malmendier 2006, 2004; Rotemberg 2004, 2002; Heidhues and Koszegi 2006, 2005)[1]. This study is concerned with optimal pricing of product quality among consumers who are averse to inequity in where there exists trade-off efficiency and its rent extraction across agents. The model used in this study relates behavior in different situations where the psychological evidence may motivate an attempt to generalize the preferences[2]. Hence, the main

* Graduate School of International Studies. Pusan National University, Jangjeon-dong, Geumjeong-gu, Pusan 609-735, South Korea. Phone: +82-51-510-2532. E-mail: choipnu@pusan.ac.kr

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[1] Ellison (2006, pp. 144) also reports that "Most topics in IO have little or no boundedly rational work on them. Most behavioral biases have received little on no consideration in IO, and even when they have been discussed it is only the most basic IO questions that have been asked." The basic assumption in this literature is that consumers make systematic mistakes and firms are rational player.

[2] The recent polemic concerning the rhetoric in the Fehr and Schmidt writings (Shaked (2006) among

purpose is on the economic implications of envy effects. Our concern for model does not suggest what psychological motives are behind the assumed behavior. If the Fehr and Schmidt (1999, 2003) research were applied to the Mussa and Rosen(1978) model, the theoretical results would be different. Considering the different quality spread vis-a-vis inequity-averse consumers, this research on social preferences focuses on altering the tradeoff between efficiency and rent extraction in an adverse selection framework.

2. The Model

The utility function of an consumer is $U = q\theta - t$: q quantity, t payment with θ in $\Theta = \{\theta_0, \theta_1\}$ respective probabilities 1-p and p. The reinterpretation[3]of these preferences views θ as the inverse of the marginal rate of substitution between income and quality rather as θ. The consumer's preferences could be written as $U = q - (t/\theta)$ if he buys a good with quality θ at price t[4]. Wealthier consumers have a lower marginal utility of income or, equivalently, a higher θ.

We follow Fehr and Schmidt's (1999) concept; (i) all consumers are inequity-averse; (ii) consumers compare themselves with other consumers; and (iii) inequity-averse consumers do not suffer if they are better off.

❑ With envy

$$R_t[\theta_i, (t_k, q_k)] = U(\theta_i, \theta_k) - \alpha \sum_{j=0,1} p_j \max[t_j - t_k, 0]$$

$$R_r[\theta_i, (t_k, q_k)] = U(\theta_i, \theta_k) - \alpha \sum_{j=0,1} \sum_{m=0,1} p_{jm} \max[U(\theta_j, \theta_m) - U(\theta_i, \theta_k), 0].$$

❑ The firm has the utility function $V = t - c(q)$, where $c'(q) > 0, c''(q) > 0$, $\lim_{q\to 0} c'(q) = 0$ and $\lim_{q\to\infty} c'(q) = \infty$.

2. Results

Benchmark: First best with $c'(q^{fb}) = \theta_i$ and second best without envy

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others) require that some discussions about the limitation of the results in experimental economics should at least be acknowledged. In fact, following Pesendorfer (2006), Fudenberg (2006) and Rubinstein (2006a, 2006b) among others, the social preferences do not completely reveal for which experiments consistency holds. However, the main purpose is to provide an analysis of an applicable economic model

[3] For an exposition of the vertical differentiation in detailed suggestions, see Tirole (1988, pp. 96-97).

[4] On this interpretation, all consumers derive the same surplus from the good, but they have different incomes and therefore, different marginal rate of substitution between income and quality $1/\theta$.

$$\theta_1 = c'(q_1^{fb}) = c'(q_1^{sb}), \qquad \theta_0 = c'(q_0^{sb}) + \frac{p}{1-p}\Delta\theta \quad \text{where} \quad \Delta\theta = \theta_1 - \theta_0$$

where sb denotes the second-best level, respectively.

2-1. Comparing Payments

❑ Given a direct revelation mechanism, the firm's program is given by

$$\begin{aligned} \max_{q_i, t_i} \quad & p[t_1 - c(q_1)] + (1-p)[t_0 - c(q_0)] \\ & R_t[\theta_1, (t_1, q_1)] \geq 0 && (PC_0) \\ & R_t[\theta_0, (t_0, q_0)] \geq 0 && (PC_1) \\ & R_t[\theta_1, (t_1, q_1)] \geq R_t[\theta_1, (t_0, q_0)] && (IC_1) \\ & R_t[\theta_0, (t_0, q_0)] \geq R_t[\theta_0, (t_1, q_1)] && (IC_0) \end{aligned}$$

❑ For a moment, suppose that $t_1 > t_0$ and (IC_0) is nonbinding

- $R_t[\theta_1, (t_1, q_1)] \geq R_t[\theta_1, (t_0, q_0)] > R_t[\theta_0, (t_0, q_0)] \geq 0$
- (PC_1) nonbinding
- (PC_0) and (IC_1) must be binding
- (IC_1) with binding and inserting it into (IC_0) yield $0 > -\Delta\theta(q_1 - q_0)$

  if the monotonicity constraint is holds strictly

❑ Optimal payment:

$$t_1 = \theta_1 q_1 - q_0 \Delta\theta, \;\; t_0 = \theta_0 q_0 - \frac{\alpha p(q_1 - q_0)}{1-\alpha p}\theta_1, t_1 - t_0 = \frac{\alpha p(q_1 - q_0)}{1-\alpha p}\theta_1 \geq 0$$

❑ Optimal quality with assumption $\alpha \in (0,1)$

$$\theta_1\left(\frac{1-\alpha}{1-\alpha p}\right) = c'(q_1^*) < c'(q_1^{fb}) = \theta_1$$

$$\theta_0 - \frac{p}{1-p}\Delta\theta + \frac{\alpha p \theta_1}{1-\alpha p} = c'(q_0^*) > \theta_0 - \frac{p}{1-p}\Delta\theta = c'(q_0^{sb})$$

❑ An analysis of q_i^* supports that the consumers' quality is strictly positive for all α. $c'(q_1^*)$ is decreasing, whereas $c'(q_0^*)$ is increasing in α; the different payments converge as α decreases. Increasing α lowers the quality for the high valuation consumer and raises that for the low valuation consumer; hence the cutoff level α^t such that q_1^* is equal to q_0^* for all $\alpha > \alpha^t$. This means that $t_1 = t_0$. As both types can be indifferent between two contracts that make the payment levels equal, inequity does not occur when consumers compare payments. The binding incentive constraint of the high valuation consumer and participation constraint of the low valuation consumer

suggest $t_1 = t_0 = \theta_1 q_i^*$ and $q_1^* = q_0^*$; thus automatically satisfying (IC_0). Otherwise, $t_1 > t_0$ if $\alpha \leq \alpha^t$.

Proposition 1: *Suppose that consumers compare payments. When the consumer is inequity averse, the optimal menu of contracts entails:*

(i) *If $\alpha \leq \alpha^t$, the difference of qualities diverges as α becomes lower and the optimal pricing of product quality is given by above equations.*

(ii) *If $\alpha > \alpha^t$, the firm offers both types of consumers a single contract.*

In proposition 1(i) the firm needs to set the increase in utility for low valuation consumers as indicated in the participation constraints of low valuation consumers $\alpha p \theta_1 (q_1^* - q_0^*)/(1 - \alpha p)$ in t_0; referred to as "payment premium" for low valuation consumers when consumers compare payments. Thus, the firm should bear the additional cost due to envy resulting from the payment gap among consumers to make low valuation consumers buy the goods. From the firm's point of view, however, this serves as an incentive for high valuation consumers to lower the quality level to save on additional cost unlike when they are not driven by envy. Nonetheless, the incentive constraints of high valuation consumers are binding. Thus, pretending to be low valuation consumers will be less profitable for high valuation consumers as in adverse selection problems because they will suffer from unfavorable payment inequity. In other words, high valuation consumers will want to keep the balance of weight between their suffering from unfavorable payment inequity and their receiving information rent to preserve their utility. Consequently, a firm offers quality that is lower than the first-best quality level. This is related to a new downward distortion for high valuation consumers. On the other hand, the upward distortion of low valuation consumers is increased by inequity aversion, i.e., the firm will serve quality that is higher than the first-best level quality when consumers compare their payments.

2.2. Comparing Rents

❑ $U_1 \leq U_0$ cannot be the appropriate incentive in the sense that the low-demand consumer never receives a rent. Given a direct revelation mechanism, the firm's program is given by

$$\max_{q_i,t_i} \quad p[t_1 - c(q_1)] + (1-p)[t_0 - c(q_0)]$$

$$R_r[\theta_1,(t_1,q_1)] \geq 0 \qquad (PC_0^r)$$

$$R_r[\theta_0,(t_0,q_0)] \geq 0 \qquad (PC_1^r)$$

$$R_r[\theta_1,(t_1,q_1)] \geq R_r[\theta_1,(t_0,q_0)] \qquad (IC_1^r)$$

$$R_r[\theta_0,(t_0,q_0)] \geq R_r[\theta_0,(t_1,q_1)] \qquad (IC_0^r)$$

Proposition 2: *Suppose that consumers compare rents. When consumers are inequity averse, the optimal pricing of product quality policy entails:*

(i) No output distortion for the high valuation consumer $q_1^r = q_1^{fb}$,

$$\theta_1 = c'(q_1^r) = c'(q_1^{fb})$$

(ii) A downward distortion for the low valuation consumer $q_0^r < q_0^{sb}$, *with*

$$\theta_0 - \frac{p(1+\alpha p)}{1-p}\Delta\theta = c'(q_0^r) < \theta_0 - \frac{p}{1-p}\Delta\theta = c'(q_0^{sb})$$

(iii) The payment for the high valuation consumer is

$$t_1^r = \theta_1 q_1^r - q_0^r(1+\alpha p)\Delta\theta.$$

(iv) The payment for the low valuation consumer is

$$t_0^r = \theta_0 q_0^r - \alpha p q_0^r \Delta\theta.$$

Proof: To solve for the maximization problem under (PC_i^r) and (IC_i^r), we momentarily ignore (IC_0^r). We will check ex post that the omitted constraint (IC_0^r) is strictly satisfied. We therefore leave three constraints, (PC_i^r) and (IC_1^r). From the program, the ability of the high valuation consumer to mimic the low valuation consumer which implies that

$$\theta_1 q_1 - t_1 \geq \theta_1 q_0 - t_0 > \theta_0 q_0 - t_0 - \alpha p[\theta_1 q_1 - t_1 - (\theta_0 q_0 - t_0)] \geq 0.$$

Thus, the high valuation consumer's (PC_1^r) is always strictly satisfied. Indeed, (PC_0^r) and (IC_1^r) immediately imply (PC_1^r). Lastly, both constraints, (PC_0^r) and (IC_1^r) must be binding at the maximization of the firm's maximization problem. Suppose that (PC_0^r) is not binding. Then the firm can decrease t_0 and t_1 by the same amount, keeping $t_1 - t_0$ is constant but increasing its profit. Therefore, (PC_0^r) is binding. Also, (IC_1^r) is binding. Otherwise the firm can increase q_1 and its profit. Thus, (IC_1^r) is binding. Ignored (IC_0^r) is given by

$$\theta_0 q_0 - t_0 - \alpha p[\theta_1 q_1 - t_1 - (\theta_0 q_0 - t_0)] \geq$$
$$\theta_0 q_1 - t_1 - \alpha p[\theta_1 q_1 - t_1 - (\theta_0 q_1 - t_1)] - \alpha(1-p)\max[\theta_0 q_0 - t_0 - (\theta_0 q_1 - t_1), 0] \qquad (*)$$

Using binding (IC_1^r), we have $\theta_0 q_0 - t_0 > \theta_0 q_1 - t_1$. Given this, Eq. $(*)$ implies $0 > -\Delta\theta(q_1^r - q_0^r)$ and thus (IC_0^r) is not binding. As a result, we must have binding constraints,

(PC_0^r) and (IC_1^r). Q.E.D.

❑ Proposition 2 suggests that optimal quality q_1^r with inequity aversion coincides with that of the canonical pricing of product quality when consumers compare rents among themselves. This is because the rent of low valuation consumers cannot be larger than that of high valuation consumers. Therefore, (IC_1^r) becomes the same as the conditions established as binding in standard adverse selection. Inequity aversion is found to influence the optimal pricing of product quality only via the rent information given to high valuation consumers. Since rent inequality is independent of the quality for high valuation consumers, quality q_1^r is realized as if there is no inequity aversion. There is no-distortion-at-the-top.

When consumers compare rents, however, inequity aversion plays an important role. Note that the quality for the low valuation consumer is determined based on the binding incentive constraint of the high valuation consumer and binding participation constraint of the low valuation consumer. In fact, the pricing of product quality policy differs from that predicted by the standard pricing of product quality policy without envy. Accordingly, to reduce inequality, the firm decreases the quality for the low valuation consumer to a level below that for the low valuation consumer's quality in standard adverse selection. Consequently, the difference in the degree of negative tradeoff derived from $q_0^r < q_0^{sb}$ and $q_1^r = q_1^{fb}$ becomes more severe than that between rent extraction and efficiency as established in the pricing of product quality in standard adverse selection.

3. Conclusion

❑ Qualities with distortion-at-the-top and distortion-at-the-bottom result and different optimal quality spread is obtained. Therefore, the theoretical analysis in this paper proposed a different optimal pricing of product quality policy for the firm because of the tradeoff relations between efficiency and rent extraction unlike those suggested by Mussa and Rosen (1978).

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