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Extracting consumer information rent by delaying the delivery of goods/services

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Abstract

A firm can relax the incentive constraint and extract extra consumer information rent by delaying the delivery of goods/services to the low type of consumers. We provide a condition for profit-increasing delays and comment on the related literature.

Keywords: Delay; Rent extraction; Bargaining; Price discrimination

JEL classification: C78; D82; L14; L15

1. Introduction

Firms often serve customers differently according to the time of delivery of goods or services. Two obvious examples are special vs. ordinary delivery of parcels, and express vs. local trains. Periodic sales at department stores may be viewed in this category as well—some customers will buy immediately at whatever price prevails, while others will wait until a sale. A well-known explanation for these "delay" practices rests on the premise that some consumers are more impatient than others or value goods/

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services more highly than others and, hence, firms may via intertemporal price discrimination exploit heterogeneous consumer preferences.[1]

This paper offers a complementary view, showing that by delaying the delivery of goods/services to the low type of consumers, a firm can relax incentive constraints and extract extra information rent from the high type of consumers. We provide a condition for profit-increasing delays and comment on the related literature in the light of our finding.

2. Model

We illustrate our idea by considering a simple model à la Mussa and Rosen (1978). The Mussa–Rosen model belongs to the so-called "monopolistic screening" models. This class of models has been widely applied in the literature, including price discrimination (Maskin and Riley, 1984), income taxation (Mirrlees, 1971) and the regulation of a monopolistic firm (Baron and Myerson, 1982). As such, our results should shed light on these closely related topics.

Our model is taken directly from Salanie (1997, Section 2.2). The setting is as follows:

(i) The utility is $U=\theta_q-t$ if the consumer buys one unit of a product of quality q at price t. The consumer plans to buy at most one unit of the product. If she decides not to buy, her utility is just zero. The positive parameter θ denotes the consumer's taste for quality, which is private information. There are two possible values of θ: $\theta_1<\theta_2$.

(ii) There is a monopolistic firm offering the product with $q\in[0,\infty]$. A unit of production of quality q costs the firm $C(q)$. It is assumed that C is twice differentiable and strictly convex with $C'(0)=0$ and $C'(\infty)=\infty$. The firm has a prior distribution denoted by $\pi=\Pr(\theta=\theta_1)$.

We augment this model by allowing for delay. That is, in addition to the offer of the menu of contracts $\{t_1,q_1\}$ and $\{t_2,q_2\}$, the firm lets the consumers know in advance that there will be delays in the delivery of goods/services. The delay associated with $\{t_1,q_1\}$ is the L period, while that associated with $\{t_2,q_2\}$ is the H period. It is assumed that the firm is able to commit to the contract offered (including delay). For simplicity, we also impose two more assumptions: (i) consumers will pay the price as soon as the firm delivers goods/services, and (ii) production takes no time so that the firm will not carry out production unless it needs to deliver goods/services.

With the above setup, the firm chooses the contracts $\{t_1,q_1,L\}$ and $\{t_2,q_2,H\}$ to solve:

$$\max\ \pi(\delta_{\mathrm{F}})^{L}[t_1-C(q_1)]+(1-\pi)(\delta_{\mathrm{F}})^{H}[t_2-C(q_2)]$$

$$\text{subject to } (\delta_{\mathrm{C}})^{H}(\theta_2q_2-t_2)=(\delta_{\mathrm{C}})^{L}(\theta_2q_1-t_1) \text{ and } (\delta_{\mathrm{C}})^{L}(\theta_1q_1-t_1)=0$$

where $0<\delta_{\mathrm{F}}<1$ and $0<\delta_{\mathrm{C}}<1$ denote the discount factors of the firm and the consumer, respectively. All the payoffs in the program are discounted appropriately when a delay occurs. The standard result that the incentive compatibility (IC) constraint for the high type and the individual rationality (IR) constraint for

[1] Wilson (1993, Section 15.1) provides a brief account of this literature.

the low type will be active at the optimum remains true in our delay program. When there is no delay (L=H=0), the above program will reduce to the no-delay problem as in Salanie (1997).

3. Analysis

We state our first result. As will be clear, this result is intuitive.

Proposition 1. *(i) The profit-maximizing condition entails: H=0 and $L\geq 0$; that is, if delay occurs, it will be associated with the low type of consumers only; (ii) no distortion for the high type of consumers; that is, the first-best production remains true in the presence of delay.*

Using Proposition 1, one can simplify the delay program:

$$\max\ \pi(\delta_F)^L[t_1 - C(q_1)] + (1-\pi)[t_2 - C(q_2^*)]$$

$$\text{subject to } \theta_2 q_2^* - t_2 = (\delta_C)^L(\theta_2 q_1 - t_1) \text{ and } \theta_1 q_1 - t_1 = 0$$

where q_2^* satisfies $C'(q_2^*)=\theta_2$, the first-best production. Compared to the no-delay program (i.e. L=0), we see that the amount of the information rent left to the high type has changed from $\theta_2 q_1 - t_1$ to $(\delta_C)^L(\theta_2 q_1 - t_1)$. Since $0<(\delta_C)^L<1$, the delay has, all else equal, relaxed the incentive constraint associated with the high type by a factor $(\delta_C)^L$. Intuitively, the high type can still earn the information rent $\theta_2 q_1 - t_1$ by mimicking the low type. However, the high type earns this information rent later rather than now when the contract intended for the low type is delayed. This implies that the amount of information rent that needs to be given up to the high type has been "shrunk" in terms of present value. Simply put, the firm can employ delay as a strategy to extract extra information rent from the consumer.

We have shown that the firm can relax the IC constraint and so mitigate the costly information rent by delaying the offer of the contract intended for the low type of consumers. This is the benefit of delay. However, there is a cost as well as a benefit to the firm arising from the practice of delay. This cost is that there is a corresponding delay in consumer payment so that, all else equal, the amount of profit earned from the low type of consumers will become smaller in terms of present value (i.e. $(\delta_F)^L[t_1 - C(q_1)]$ instead of $[t_1 - C(q_1)]$). By putting the benefit and the cost together, a tradeoff is involved in the design of delay.

Since it would not pay for the low type to mimic the high type (the IC constraint is not active for the low type), no further rent can be extracted as a result of delaying the offer of the contract intended for the high type. This explains why H=0 in Proposition 1. This also explains why there is no distortion for the high type in the presence of delay.

With $q_2 = q_2^*$, the firm that does not practice delay should maximize (Salanie, 1997, p. 24):

$$\pi(\theta_1 q_1 - C(q_1)) - (1-\pi)(\theta_2 - \theta_1)q_1 \tag{1}$$

With the augmentation of delay, Eq. (1) will become:

$$\pi(\delta_F)^L(\theta_1 q_1 - C(q_1)) - (1-\pi)(\delta_C)^L(\theta_2 - \theta_1)q_1 \tag{2}$$

Thus, given delay L, the optimal q_1^* in the presence of delay satisfies:

$$C'\left(q_1^*\right) = \theta_1 - \left(\frac{\delta_C}{\delta_F}\right)^L \cdot \frac{1-\pi}{\pi}(\theta_2 - \theta_1) \tag{3}$$

Since $q_2^*>q_1^*$ and that H=0 and $L\geq 0$, the high type of consumers will be served with less delay as well as higher quality than the low type in general. This prediction seems consistent with casual observations (say, Concorde or Federal Express).[2]

Given a contract intended for the low type, should the firm delay that contract at all? Using Eq. (2) and applying the envelope theorem, the marginal expected profit from a further delay at any L equals:

$$\pi(\delta_F)^L \ln \delta_F \left(\theta_1 q_1^* - C\left(q_1^*\right)\right) - (1-\pi)(\delta_C)^L \ln \delta_C (\theta_2 - \theta_1) q_1^* \tag{4}$$

Evaluating Eq. (4) at L=0, we obtain:

Proposition 2. *Delay will be profit-increasing if and only if the following inequality holds*

$$\delta_F > (\delta_C)^{\varepsilon} \tag{5}$$

Where $\varepsilon \equiv (1-\pi)(\theta_2-\theta_1)q_1^*/\{\pi[\theta_1 q_1^* - C(q_1^*)]\}$.

The inequality (5) is simply to check whether the expected reduction in information rent given up to the high type due to delay at L=0 is large enough to compensate for the expected loss in profit earned from the low type.

When $\delta_F=\delta_C$, the inequality (5) will reduce to:

$$\varepsilon > 1 \tag{6}$$

Since $dq_1^*/dL=0$ if $\delta_F=\delta_C$, a further delay at any $L>0$ will be profit-increasing once the inequality (6) holds at L=0. This implies in this case that the firm should let $L\rightarrow\infty$ and exclude the low type of consumers from the market if it is worthwhile to delay at all.

When $\delta_F=\delta_C$, the optimal policy for the firm is either no delay or infinite delay. Consider the case where $\delta_F\neq\delta_C$. Given q_1, the optimal delay L^* is determined by setting (4) equal to zero. The optimal quality q_1^* and the optimal delay L^* can be solved together through the system of this equation and Eq. (3). It is clear that the optimal delay L^* derived may be positive but finite.

4. Comments on the related literature

Laffont and Martimort (2002, Chapter 2) consider a model in which the principal wishes to delegate the production of a good to agents. They note that the principal may offer a contract with shutdown—excluding the high-cost type from the market. The tradeoff involved in their shutdown policy is essentially the same as that captured by our exclusion decision rule (6) under $\delta_F=\delta_C$.

Ausubel et al. (2002, Section 3.1.1) (hereafter, ACD) consider a multistage model of bargaining in which the uninformed seller makes offers to the informed buyer in each period. The game continues until the buyer accepts an offer. In a two-type model with an indivisible bargaining object, they show (in terms

[2] Also, shoes or clothes in your size are often unavailable during periodic sales.

of our notation): If $(1-\pi)\theta_2<\theta_1$ and $\delta_F=\delta_C=\delta$, the unique sequential equilibrium outcome is that the seller charges a single price θ_1 and all buyer types accept the offer without delay. By appealing to Stokey (1979) and Riley and Zeckhauser (1983), ACD note that this is also the outcome when the seller can make commitments to a sequence of offers.

This result can be derived using our model. Let $q_1=q_2\equiv 1$ and $C(.)\equiv 0$, which matches the setting in ACD, namely, an indivisible bargaining object with the seller's cost being normalized to zero. With this simplification, the delay program in Section 2 will reduce to:

$$\max \ \pi\ (\delta_F)^L\ t_1+(1-\pi)t_2$$

$$\text{subject to } \theta_2-t_2=(\delta_C)^L(\theta_2-t_1) \text{ and } \theta_1-t_1=0 \tag{7}$$

Substituting in Eq. (7) and calculating the marginal expected profit from a further delay at any L yields:

$$\pi(\delta_F)^L(\ln\delta_F)\theta_1-(1-\pi)(\delta_C)^L(\ln\delta_C)(\theta_2-\theta_1) \tag{8}$$

Imposing the restriction $\delta_F=\delta_C=\delta$, Eq. (8) gives:

$$(\delta)^L(\ln\delta)[\pi\theta_1-(1-\pi)(\theta_2-\theta_1)] \tag{9}$$

On the basis of Eq. (9), a profit-maximizing firm should choose no delay if and only if $(1-\pi)\theta_2<\theta_1$. Once $L=0$, it is immediate from Eq. (7) that $t_1=t_2=\theta_1$.

Note that this result relies upon the restriction $\delta_F=\delta_C=\delta$. When $\delta_F\neq\delta_C$, a profit-maximizing firm should choose no delay if and only if $(1-\pi)(\theta_2-\theta_1)<(\ln\delta_F/\ln\delta_C)\pi\theta_1$ (evaluating Eq. (8) at $L=0$). If $\delta_F\geq\delta_C$, $(1-\pi)\theta_2<\theta_1$ implies this inequality. However, the implication is no longer true if $\delta_F<\delta_C$. In a bargaining setting similar to ACD (but where the game lasts two periods only), Fudenberg and Tirole (1983) point out that the "non-haggling" result of Stokey (1979) and Riley and Zeckhauser (1983) may not hold if $\delta_F<\delta_C$. Sobel and Takahashi (1983) make a similar point in a bargaining setting similar to ACD (but there is a continuum of buyer types). The result here is basically the same as their findings. Of course, our delay-or-not condition (Proposition 2) is more general in that quantity/quality in our setting is allowed to be variable.

Wang (1998) analyzes a bargaining game similar to ACD, except that the bargaining object is divisible so that quantity/quality is variable. With a common discount factor, he shows that the unique sequential equilibrium outcome is without delay and is the same as the one in one-shot bargaining in which the seller can make commitments to offer a take-it-or-leave-it menu of contracts. Wang's analysis is incomplete in the following two senses. First, he did not consider the case where the seller's patience differs from the buyer's. Our Proposition 2 indicates that delay may occur in this case even if the seller can commit to their menu offer. Secondly, according to Laffont and Martimort (2002, Chapter 2) or our finding, even if the seller and the buyer have the same patience, delay or, more precisely, infinite delay may still result.

References

Ausubel, L.M., Cramton, P., Deneckere, R.J., 2002. Bargaining with incomplete information. In: Aumann, R.J., Hart, S. (Eds.), Handbook of game theory with economic applications, vol. 3. North-Holland, Amsterdam, pp. 1897–1945.

Baron, D.P., Myerson, R.B., 1982. Regulating a monopolist with unknown costs. Econometrica 50, 911–930.

Fudenberg, D., Tirole, J., 1983. Sequential bargaining with incomplete information. Rev. Econ. Stud. 50, 221–247.
Laffont, J.-J., Martimort, D., 2002. The theory of incentives: the principal-agent model. Princeton University Press, Princeton.
Maskin, E., Riley, J., 1984. Monopoly with incomplete information. Rand J. Econ. 15, 171–196.
Mirrlees, J., 1971. An exploration in the theory of optimum income taxation. Rev. Econ. Stud. 38, 175–208.
Mussa, M., Rosen, S., 1978. Monopoly and product quality. J. Econ. Theory 18, 301–317.
Riley, J., Zeckhauser, R., 1983. Optimal selling strategies: when to haggle, when to hold firm. Q. J. Econ. 98, 267–289.
Salanie, B., 1997. The economics of contracts: a primer. The MIT Press, Cambridge.
Sobel, J., Takahashi, I., 1983. A multi-stage model of bargaining. Rev. Econ. Stud. 50, 411–426.
Stokey, N.L., 1979. Intertemporal price discrimination. Q. J. Econ. 93, 355–371.
Wang, G.H., 1998. Bargaining over a menu of wage contracts. Rev. Econ. Stud. 65, 295–305.
Wilson, R.B., 1993. Nonlinear pricing. Oxford University Press, Oxford.