Advertising Information, Advertising Precision and Resale Price Maintenance

Sheng-Yeh Wu
I-Shou University

Suli Lin
I-Shou University

Guan-Ru Chen
I-Shou University

Kai-Chi Hsu
I-Shou University

Liang-Yu Heish
I-Shou University

As consumers use the retail price as an estimator of product quality, the producer expects the retail price to efficiently signal the quality information. However, in the presence of price competition among retailers, consumers cannot predict quality by observing prices because they cannot identify whether the price discounts result from quality downgrade, or just retail supply's increase. Since market price movements send noises over quality judgement, the producer uses resale price maintenance to control noises from retail supply. When resale price maintenance is prohibited by antitrust law, a rational expectations model predicts that the manufacturer can replace resale price maintenance with advertising.

INTRODUCTION

Advertising and resale price maintenance (RPM) are the main two marketing practices. However, the topic of the relationship between advertising and RPM has rarely been studied. Advertising provides information and establishes brand loyalty among consumers of advertised products. Resale price maintenance (RPM) specifies the final price that retailers charge consumers. Exploring the theoretical basis of the relationship between advertising and RPM, which is this paper's main objective, has implications for channel coordination, price rigidity and antitrust policymaking. After RPM was prohibited, Corning Glass Works was found to increase its advertising expenditures (Ippolito and Overstreet, 1996). On the other hand, price discounts are often offered on heavily advertised products. Eskin and Baron (1977) find that increases in advertising expenditures increase price sensitivity and make price reduction become a more effective way of inducing sales quantities. Albion (1983, p131) observed: "Those brands that are good loss leaders, proposed to be mostly the well-known, highly advertised brands..." et al. (2006) also found less price rigidity among national branded products than private label products.

Resale price maintenance (RPM) is the most important vertical restraint in terms of both its frequency of use and the number of legal cases generated (Mathewson and Winter, 1998, p.60). The motivation behind RPM has been a long-lasting puzzle that many scholars have sought to explain using various models. Telser (1960) argued that if the distributors are not protected by RPM, this enables price discounters to "free ride" on other dealers' investments which involve substantial costs for pre-sales services. Marvel and McCafferty (1984) indicated that the reputation of a retailer has a positive effect on the consumers' perceived quality. They showed that RPM will be adopted when a manufacturer wishes to purchase quality certification from reputable retailers. RPM induces high-quality dealers to carry inventories by protecting their margin. Klein and Murphy (1988) indicated that RPM induced desired dealer services by offering the retailers a guaranteed margin and threatening termination if they did not live up to expectations. Deneckere et al. (1996) indicated that, by means of an appropriate resale price, a manufacturer can encourage retailers to hold inventories by rewarding them.

However, an opposing explanation proffers that RPM prevents consumers who do not value retailers' services from purchasing products at lower prices, regardless of whether or not price-fixing measures are applied to ensure the retailers make a profit or to serve as a cartel between upstream and downstream profits. The Supreme Court of the United States was skeptical of the evidence supporting the service argument because RPM is used for a much wider variety of products than that argument would suggest (Business Electronics Corp. v. Sharp Electronics Corp., 485 U.S. Supreme Court 717, 1988). Mathewson and Winter (1998, p.59) wrote: "The lack of consensus on the appropriate policy towards vertical restraints is matched by a variation over time in the legal status of restraints in the U.S." RPM is a popular marketing practice, and economic theory may affect its legal status.

This paper assumes that the coverage of advertising increases with the manufacturers' advertising expenditures. Given a certain amount of advertising expenditures, the consumers are divided into two groups. The consumers in one group can receive the advertising information, who are denoted as informed consumers, as well as use advertising information and the retail price to infer product quality. The consumers in the other group do not receive the advertising information, are denoted as uninformed consumers, and only use the retail price as the indicator of product quality. The retail price aggregates the advertising information from the informed consumers, and then reveals it to uninformed consumers. The beliefs of uninformed consumers in regard to quality depend on the information conveyed by the equilibrium retail price. The manufacturer expects the retail price to efficiently communicate information regarding quality. However, in the presence of intrabrand price competition, consumers cannot use the retail price as an efficient predictor because they cannot distinguish whether the price movements reflect the variance in terms of quality or the variance in terms of the quantities supplied by retailers. Intrabrand price competition perturbs consumers' predictions of quality and thus increases the uncertainty faced by consumers and results in a lower average retail price.

Retailers do not optimize the prices of individual brands; instead, they optimize prices for the store as a whole. Therefore, retailers have strong incentives to engage in intrabrand price competition in order to earn a reputation for being loss leaders. The "loss leading schemes," also referred to as "variable price merchandising" that constantly raise and lower the prices of various products, give rise to the price variation. As long as a product can draw store traffic, retailers are willing to sacrifice their margins to hold this product. This price variation thus hinders the consumers' ability to correctly predict a product's quality, because the accuracy of the information communicated by the price is reduced. This paper argues that when faced with intrabrand price competition, manufacturers use RPM to communicate information regarding a product's quality through pricing.

However, RPM is prohibited in most OECD (Organisation for Economic Co-operation and Development) countries, subject to a few exceptions that are mostly for books, newspapers, and similar cultural products (OECD, 1997). Even if RPM is not prohibited, the success of the manufacturers in imposing it on retailers is not certain. The objective of RPM is to recoup the price-setting right from retailers, and so the implementation of RPM depends on the power of the manufacturers relative to the retailers. The growing power of modern retailers, such as Wal-Mart, Carrefour and Tesco, may make it difficult for manufacturers to impose RPM. As reported in Dobson (2005), the top four retailers in Britain

account for two-thirds of all grocery product procurement, and control in excess of 94 percent of sales through large supermarkets (greater than 1,400 square meters). Even the very largest brand manufacturers will find it difficult to exercise control over the retailers. When RPM is unavailable to the manufacturer, the rational expectations model shows that advertising can serve as a substitute for RPM.

THE MODEL

Lucas (1972), who developed the concept of an equilibrium in which individuals make use of the statistical relationships between endogenous and exogenous variables, initiated the rational expectations equilibrium model. Grossman (1976) analyzed an economy in which traders hold diverse information regarding the return on assets and claimed that investors can infer the asset's return only through the price because all information is contained therein. Grossman and Stiglitz (1980) proposed that the market must contain a source of noise that prevents agents from obtaining all their information from the price and created an incentive to expend resources on obtaining information. Hellwig (1980) argued that as the noise comes from the supply side, the price cannot provide sufficient information; thus, simply observing the price cannot provide enough information to predict the asset's return. Admati (1985) provided generalized solutions for the rational expectations equilibrium models developed by Hellwig (1980). The model presented in this paper is based on the work of Hellwig (1980) and Admati (1985). In terms of the marketing implications of our argument, the model in this paper assumes that a proportion of consumers infer quality both from advertising information and the retail price, while others merely observe retail price as a predictor of quality. The model shows that the increasing number of consumers who receive advertising information gives rise to a substitution effect on RPM. The loss from intrabrand price competition can be offset by the increasing proportion of informed consumers.

Consider a manufacturer that produces one product and faces finite numbers of consumers. Let $\lambda \in (0,1)$ be the fraction of consumers whose expectations regarding quality are based on advertising information and the retail price is denoted by informed consumers. The $1-\lambda$ fraction of consumers who infer quality only by observing the retail price is denoted by uninformed consumers. Except for the retail price and advertising, consumers have no other ways of accessing quality information. Other assumptions are described as follows.

Suppose that the consumers can exchange the utility obtained from the product for monetary units. Under this assumption, consumers can evaluate the product's quality in monetary terms. The consumers' demand quantities, z_d, can be derived by maximizing the expected utility:

$$z_d = \gamma Var(\tilde{q}|\Omega)^{-1}(E(\tilde{q}|\Omega) - \tilde{p}), \tag{1}$$

where Ω is the information set on which consumers base their expectations.The value of advertising information received by informed consumers is

$$\tilde{a} = \tilde{q} + \tilde{\varepsilon} \tag{2}$$

where $\tilde{a}$ denotes the advertising information received by consumers, and $\tilde{a}$ expresses the true quality, $\tilde{q}$, perturbed by noise $\tilde{\varepsilon}$, $\tilde{\varepsilon} \sim N(0,s)$, $s>0$. Higher s represents more noise contained in the information. So we let s^{-1} denote the precision of information. Assume that $\tilde{\varepsilon}$ and $\tilde{q}$ are independent. The demand quantities of informed consumers and uninformed consumers are $z_d(a,p)$ and $z_d(p)$, respectively. Assume that the random vector $(\tilde{q},\tilde{a},\tilde{p})$ has a joint normal distribution. For informed consumers, the posterior distribution of $\tilde{q}$, given a realization $(\tilde{a},\tilde{p})$, is again normal, and the mean and variance take the following form:

$$E(\tilde{q}|\tilde{a},\tilde{p}) = h_0 + h_1\tilde{a} + h_2\tilde{p} \tag{3}$$

$$Var(\tilde{q}|\tilde{a},\tilde{p}) = v_0 \tag{4}$$

For uninformed consumers, the expected quality, which is conditional upon the retail price, is as follows:

$$E(\tilde{a}|\tilde{p}) = c_0 + c_1\tilde{p} \tag{5}$$

$$Var(\tilde{a}|\tilde{p}) = d_0 \tag{6}$$

Assume that he manufacturer achieves the desired outcome of RPM by reducing the variance of the retailers' supply quantities. This assumption is necessary for the market clearing conditions. The per capita retail supply is denoted by $\tilde{z}_s$, where the $\tilde{z}_s \sim N(\bar{z},u)$ where $\bar{z}, u > 0$ are independent of $\tilde{\varepsilon}$. In markets where extensive distribution systems are necessary, goods are purchased and stocked by retailers after being produced. Retailers can accumulate a certain amount of goods and release them on one occasion while providing price discounts. Reducing the quantity variance, u, is a necessary condition for imposing RPM. A higher value of u represents that the intrabrand price competition is more intense, the manufacturer implements RPM by reducing u.

Under the above assumptions, the equilibrium price, $\tilde{p}$, can be derived by solving the following equation:

$$z_s = \lambda\gamma\frac{\left[E(\tilde{q}|\tilde{a},\tilde{p}) - \tilde{p}\right]}{Var(\tilde{q}|\tilde{a},\tilde{p})} + (1-\lambda)\gamma\frac{\left[E(\tilde{q}|\tilde{p}) - \tilde{p}\right]}{Var(\tilde{q}|\tilde{p})} \tag{7}$$

ADVERTISING AND RPM

The equilibrium price obtained from equation (7) is expressed in Lemma 1. Quality-related advertising can be conveyed by the retail price, but is perturbed by noise from the retail supply. The amount of quality information a consumer acquires is determined, in part, through price. The retail price, in turn, depends on the amount of quality information that consumers acquire. The equilibrium retail price and information acquisition have to be solved simultaneously because each one affects the other.

Lemma 1. The rational expectations price, $\tilde{p}$, for a given value of λ is a linear function of advertising information, $\tilde{a}$, and of the per capita retail supply, $\tilde{z}_S$.

$$\tilde{p} = b_0 + b_1\tilde{a} - b_2\tilde{z}_s \tag{8}$$

where

$$b_0 = \frac{v_0 d_0}{(\lambda d_0 + (1-\lambda)v_0)}\left[\frac{1}{v}\bar{q} + \frac{\gamma\lambda}{(\gamma^2\lambda^2 + us)}\bar{z}\right]$$

$$b_1 = \frac{v_0 d_0}{(\lambda d_0 + (1-\lambda)v_0)}\frac{\lambda}{s}\left[1 + \frac{\gamma^2\lambda}{\gamma^2\lambda^2 + us}\right]$$

$$b_2 = \frac{v_0 d_0}{(\lambda d_0 + (1-\lambda)v_0)}\frac{1}{\gamma}\left[1 + \frac{\gamma^2\lambda}{\gamma^2\lambda^2 + us}\right]$$

$$v_0 = \left[v^{-1} + s^{-1} + (s + us^2(\gamma\lambda)^{-2})^{-1}\right]^{-1}$$
$$d_0 = \left[v^{-1} + (s + us^2(\gamma\lambda)^{-2})^{-1}\right]^{-1}$$

Proof: Substituting (3), (4), (5), and (6) into (7), we obtain

$$b_0 = \frac{\lambda h_0 d_0 + (1-\lambda)c_0 v_0}{\lambda(1-h_2)d_0 + (1-\lambda)(1-c_1)v_0} \tag{9a}$$

$$b_1 = \frac{\lambda h_1 d_0}{\lambda(1-h_2)d_0 + (1-\lambda)(1-c_1)v_0} \tag{9b}$$

$$b_2 = \frac{d_0 v_0}{(\lambda(1-h_2)d_0 + (1-\lambda)(1-c_1)v_0)\gamma} \tag{9c}$$

Given assumption A.4., the triple $(\tilde{q}, \tilde{a}, \tilde{p})$ is normally distributed with variance-covariance matrix Σ: $\Sigma = \begin{bmatrix} v & v & vb_1 \\ v & v+s & vb_1 \\ vb_1 & vb_1 & b_1^2(v+s) + b_2^2 u \end{bmatrix}$. Following the techniques in Admati (1985), we can obtain the values of v_0, d_0, h_1, and h_2, and by substituting them in (9a), 9(b), and 9(c), we have Lemma 1. Q.E.D.

The price in equation (8) aggregates the advertising information from informed consumers, and then reveals it to the uninformed consumers. Chan and Leland (1982) and Cooper and Ross (1984) demonstrate that when both informed and uninformed consumers exist in a market, the price conveys information about product quality; thus, informed consumers provide a positive externality to uninformed consumers. However, the equilibrium price in equation (8) cannot be a sufficient statistic for the product's quality, since the noise comes from the retail supply. Manufacturers are concerned with how the expectation of the equilibrium prices, $E(p)$, is affected by changes in the parameters of the probability distribution and the proportion of informed consumers. Since the lower expected retail price represents lower demands, this inevitably results in lower revenue that the manufacturers receive from the retailers. Proposition 1 indicates how the intensity of intrabrand price competition impacts the expectation of the equilibrium price.

Proposition 1. The higher the variance of the supply quantity, u, leads to the lower expectation of the equilibrium price, $E(\tilde{p})$.

Proof: The expectation of the equilibrium price can be obtained by calculating the expectation in (8):

$$E(p) = \bar{q} - \frac{d_0 v_0}{(\lambda d_0 + (1-\lambda)v_0)\gamma}\bar{z} \tag{10}$$

We now show that $\partial E(p)/\partial u < 0$.

Equation (10) can be rewritten as follows:

$$E(\tilde{p}) = \bar{q} - \left[\lambda v_0^{-1} + (1-\lambda)d_0^{-1}\right]^{-1}\gamma^{-1}\bar{z} \tag{10a}$$

Differentiating v_0^{-1} and d_0^{-1} with respect to u gives

$$\frac{\partial v_0^{-1}}{\partial u} = \frac{\partial d_0^{-1}}{\partial u} = -\left[s + us^2(\gamma\lambda)^{-2}\right]^{-2} s^2(\gamma\lambda)^{-2} < 0 .$$

Therefore, it follows that

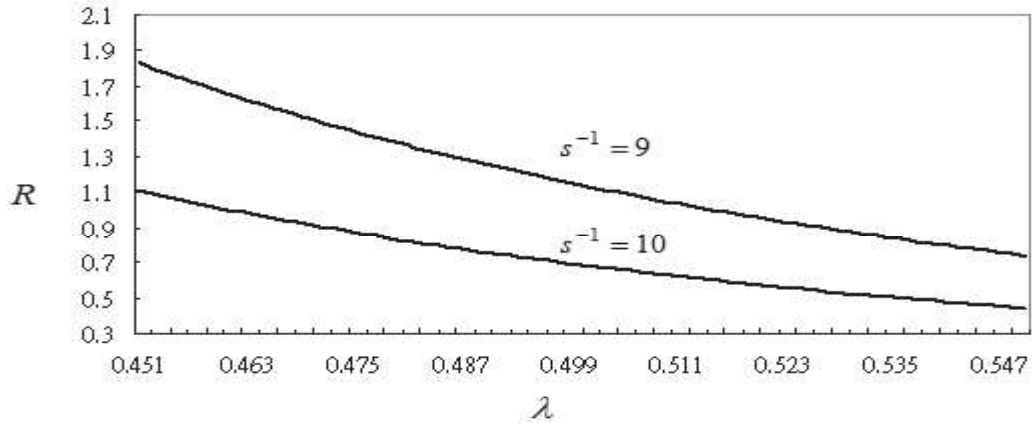
$$\frac{\partial E(\tilde{p})}{\partial u} = \left[\lambda v_0^{-1} + (1-\lambda)d_0^{-1}\right]^{-2}\left[\lambda\frac{\partial v_0^{-1}}{\partial u} + (1-\lambda)\frac{\partial d_0^{-1}}{\partial u}\right]\gamma^{-1}\bar{z} < 0 \quad \text{.Q.E.D.}$$

Proposition 1 explains why a manufacturer uses RPM. Because RPM reduces U, then $E(P)$ increases. As previously noted, intrabrand price competition involves price movements, and a more volatile supply quantity is a necessary condition for a more volatile retail price in order to ensure market clearing at any given time. Hence, we use the variance of the supply quantity, u, to represent the intensity of intrabrand price competition. Intrabrand price competition perturbs consumers' predictions of quality; therefore, it increases the uncertainty faced by consumers, resulting in a lower expected price that consumers are willing to pay. For example, if a retailer frequently offers price discounts on a product, consumers cannot distinguish whether it reflects low quality or is just a result of increasing quantity. As u increases, the consumers' uncertainty over quality will increase because the equilibrium retail price is not reliable enough to be a predictor of quality. Consumers will demand a higher risk premium to compensate for the additional uncertainty they face, and hence the price that they are willing to pay will decrease. Dodson et al. (1978) studied the effects of different types of coupons on consumers' loyalty behavior and found that price promotions reduce future purchase probabilities. Similar conclusions were drawn by Jones and Zufryden (1981), who found that the repurchase probability after purchasing on-promotion items was lower than that of not purchasing promotional items. Kalyanaram and Winer (1995) indicated that the promotions erode purchase probabilities by lowering reference prices. As a result, consumers might be more reluctant to pay regular prices or to tolerate price increases.

The absolute value of $\partial E(\tilde{p})/\partial u$ can be seen as the benefit of RPM. As previously noted, reducing the variance of retail supply u is a necessary condition for imposing RPM. So we denote the $R = \left|\partial E(\tilde{p})/\partial u\right|$ as the benefit of imposing RPM. Then we use numerical method to show how other variables affect R. Higher R represents that the manufacturer has more incentives to use RPM.

FIGURE 1
THE BENEFIT OF RPM

$u = 0.1,\quad \gamma = 0.1,\quad v = 0.1,\quad \overline{Z} = 10$



In Figure 1, we can see as the more consumers receive private information, the fewer manufacturers incentives to use RPM. As previously noted, R represents the benefit of using RPM, a decrease in R means that the demand for RPM declines. Figure 1 indicates that as the proportion of informed consumer increases, the need for using RPM declines. The economic intuition is explained as follows. The demand for the product, which is given in equation (1), indicates that a decrease in $Var(\tilde{q}|\Omega)$ leads to a higher value of the product. First, we compare the $v_0 = Var(\tilde{q}|\tilde{a},\tilde{p})$ and $d_0 = Var(\tilde{q}|\tilde{p})$ in equation (8). Observing additional information reduces the conditional variance of informed consumers, and therefore the v_0 is lower than d_0. This means that the average uncertainty faced by all consumers decreases as more consumers access advertising information. In addition, as more consumers observe advertising, the more information regarding quality is revealed by the retail price. So the conditional variance of quality faced by uninformed consumers declines due to the more reliable information reflected by the price. The value of a product to a risk-averse customer is lower than the product's value would be if all information were available. As more customers observe information, more of the uncertainty is removed and the value of the product increases.

When the proportion of informed consumers increases with the advertising expenditures, the need for RPM declines because the dependence on the retail price for purchase decision-making gradually decreases. Dodds et al. (1991) show that the consumers use price as a signal of quality if they lack information to make a choice. However, the dependence on price for assessing quality declines in the presence of other information such as brand names and advertising. On the other hand, a number of studies find that advertising increases the price sensitivity of consumers (Eskin and Barron, 1977; Wittink, 1977; Schroeter et al. 1987). Advertising causes the price reduction to become a more effective way of inducing sales quantities. This is because, when the proportion of consumers who possess advertising information is low, the price reduction may not bring expected results due to the increase in uncertainty over quality. Advertising reduces the uncertainty over quality resulting from price variations and makes the demand curve more elastic. In practice, the products that appear most frequently in sales promotion are maturing and heavily-advertised brands. Albion (1983, p131) finds that price promotions are often provided on the heavily-advertised goods. These are often famous brands that are nationally available and widely used. Therefore, consumers will not be confused by the price variation, which has a negative effect on prices in the long run when there are fewer informed consumers. This result needs to be considered in the antitrust policy making. The necessity of granting exemption for RPM decreases when more consumers access private information. Figure 1 also indicates the more information precision reduces the

need for imposing RPM. The higher s^{-1} (or the less s) reduces the uncertainty faced by all consumers. For informed consumers, the higher s^{-1} let private information communicate more accurate value of quality. For uninformed consumers, the higher s^{-1} let retail price reveal quality information with less noise. The demand for adopting RPM reduces if consumers could purchase with precise information. This result gives an implication for antitrust policy maker, if the regulator enforces the law of false advertising (misleading advertising) more strictly, the necessity of granting exemption for RPM will decrease accordingly.

CONCLUSIONS

This model divides consumers into two groups: those who infer quality strictly by observing the retail price and those who infer quality using both advertising information and the retail price. The noise of price from retailers increases consumers' uncertainty regarding quality and imposes a negative externality on manufacturers. Marketing decision-makers must determine an appropriate pricing strategy that accounts for negative externalities from intrabrand price competition. The consumers' uncertainty over a product's quality, which can be affected by the pricing strategy adopted, plays a major role in the product's prospects for success. A volatile price makes uninformed consumers feel "unsafe" regarding the product's quality because they cannot determine whether the price discount reflects low quality or if it is merely a result of increased retail supply. In the presence of supply noise, the retail price does not fully reveal advertising information regarding quality, and thus manufacturers are encouraged to adopt RPM. When RPM is unfeasible, the manufacturer increases advertising expenditures to transmit quality information. The need for RPM to let price reveal quality decreases, the result of which is a substitution effect of advertising on RPM. In general, RPM is prohibited in most OECD (Organisation for Economic Co-operation and Development) countries (OECD, 1997). Opponents question whether RPM is used for a much wider variety of products than the service argument would suggest. They contend that manufacturers use RPM to maintain cartel prices and reduce competition among retailers. This paper suggests that in the rational expectations model, RPM may be used to inhibit the mobility of a price rather than to maintain a sufficiently high price. As the number of uninformed consumers decreases, the risk reduction role of RPM gradually diminishes as well. The need for RPM to ensure that price efficiently communicates information declines as advertising information diffuses and advertising precision increases. The results regarding the relationship between advertising and RPM should thus be considered in antitrust policymaking and market decision-making.

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