Analyzing the NonLinear Pricing Strategy of Cibo using an Adverse Selection Game Theory Model

Dickson A. Lim
School of Economics, De La Salle University, Manila, Philippines
dickson_lim32@yahoo.com / dickson.lim@dlsu.edu.ph

With the inability of \textit{Cibo} to correctly identify their patrons of which segment or type they are, a nonlinear pricing scheme was developed by the restaurant in the form the \textit{La Familia} option. The \textit{La Familia} option is a price discrimination strategy that attempts to extract surplus from either segment or type; but due to adverse selection, the product offering exhibits distortion to one of the segment or type.

\textit{Keywords:} nonlinear pricing, price discrimination, adverse selection, restaurant management, game theory

INTRODUCTION

\textit{Cibo}, an Italian restaurant that was established in 1997 by Margarita Fores with a goal of becoming the country’s most beloved Italian dining destination \cite{Cibo Website}. \textit{Cibo} has been serving Italian pasta as either for single order or a good-for-two option, which they termed \textit{La Familia}. Using one of the pasta dishes, a single order would cost a customer P 263.00 which would contain 41 ribbon noodles; while a good-for-two option would cost a customer P 465.00 which would contain 70 ribbon noodles. Hence, the restaurant basically provides its clients two options, either to buy the pasta dish at P 263.00 with 41 ribbon noodles, or at P 232.50 with 35 ribbon noodles. The \textit{La Familia} option is basically a form of price discrimination, a pricing strategy. Price discrimination is defined as segmenting the market and offering different prices based on the elasticity characteristic of these segments \cite{Kotler, 2006}. This strategy enables the business to extract all surplus from the consumer. The \textit{La Familia} option has is considered a price discrimination strategy since \textit{Cibo} has segmented the market to the high type which would order two single orders for themselves plus for their companion; and the low type which would order the \textit{La Familia} option for themselves and their companion. Another pricing strategy considered with the \textit{La Familia} option is nonlinear pricing. Nonlinear pricing involves a discount in the price with increase in the number of units \cite{Dolan, 1996}; it is a form of volume discount. The increase in noodle quantity...
of what the low type will order from that of the high type is \([(41 – 35)/35 =] 17.14\%; while the increase in price is \([(P 263 – P 232.50)/P 232.50 =] 13.12\%.

The rationale behind this marketing strategy by Cibo can be modeled using game theory with asymmetric information. The 1st stage of the game is where nature determines the type of patron; followed by the 2nd stage where Cibo sets the price and quantity in the form of a menu/product offering; and lastly the 3rd stage, where the patron will accept or reject the product offering. There is asymmetric information because the restaurant does not know which type the consumer is (whether a low type or a high type), and will most likely set a price that is the average of what the high and low type are willing to pay. However the price set will discourage the low types from patronizing the restaurant, and the restaurant is thus unable to extract the extra surplus that could be obtained from the high types (Snyder, 2008). The objective of this paper is to analyze if Cibo’s strategy is consistent with theory.

**THEORETICAL FRAMEWORK**

Snyder and Nicholson in *Microeconomic Theory* (2008) were able to use a simple model to show that under an adverse selection setting, there is distortion to the low type’s product offering while there is no distortion to the high type’s product offering. Assume that the utility of a consumer has the form

\[ u = \lambda v(q) - P \]

where q is the units of the product, v(q) is a concave value function, where \( v'(q) > 0 \) and \( v''(q) > 0 \). This property indicates a diminishing return to utility of the consumer as he or she consumes more of the product; \( \lambda \) is the consumer’s type that can either have a value of \( \lambda_H \) for the high type with probability \( \rho \), or \( \lambda_L \) for the low type with probability \( 1 - \rho \) and \( \lambda_H > \lambda_L \). \( \lambda v(q) \) represents the consumer’s benefit from consuming the product and \( T \) is the tariff or price paid by the consumer, which represents the consumer’s cost from consuming the product.

The restaurant maximizes the objective function:

\[ \Pi = P - cq \]

where \( \Pi \) is the profit of the restaurant which relies on \( P \) the price charged to consumers less \( cq \) the cost of producing the product. \( c \) is the fixed marginal cost of producing the product and \( q \) is number of quantities of the product produced.

**Full Information Case**

Under the full information case, the restaurant can immediately observe the consumer’s type and charge him/her the price at which he or she is most willing to pay in order to extract all surpluses from the consumer. In this case, the restaurant’s objective function is only limited by the participation constraint:

\[ \lambda v(q) - P \geq 0 \]

since the restaurant can observe the consumer’s type; and it can set \( P \) as high as possible and the constraint can be written at equality:

\[ \lambda v(q) = P \]

Substituting the constraint to the restaurant’s objective function, so we have:

\[ \Pi = \lambda v(q) - cq \]

To maximize the objective function, we take the first-order derivative of the function with respect to \( q \) and set it to zero; we obtain:

\[ \frac{\partial \Pi}{\partial q} = \lambda v'(q) - c = 0 \]

\[ \lambda v'(q) = c \]
Here we have the fact that the marginal benefit of consuming the product by the consumer is equal to the cost of producing the product. This equation is satisfied for both values of $\lambda_H$ and $\lambda_L$.

**Asymmetric Information Case**

Under the condition that the restaurant cannot observe the consumer’s type, there is an incentive for the high type to deviate from Nash equilibrium and consume the quantity supposedly marketed to the low type, since $\lambda_H > \lambda_L$ implies $\lambda_H v'(q) = c > \lambda_L v'(q) = c$. Thus, the high type can be charged with a lower marginal cost by claiming he or she is a low type. By using backward induction, we first determine the quantity consumed by each type of consumer, then determine the price that the restaurant will set in order to maximize profit.

The restaurant’s objective function will be in the form:

$$\rho (\lambda_P q - cq_P) + (1 - \rho) (\lambda_L q - cq_L)$$

subject to four constraints:

1. $\lambda_L v(q_L) - P_L \geq 0$
2. $\lambda_H v(q_H) - P_H \geq 0$
3. $\lambda_L v(q_L) - P_L \geq \lambda_L v(q_H) - P_H$
4. $\lambda_H v(q_H) - P_H \geq \lambda_H v(q_L) - P_L$

where constraints (1) and (2) are the participation constraints and (3) and (4) are the incentive constraints. We claim that constraints (2) and (3) are nonbinding constraints, for the following reasons: the participation constraint of the high type is satisfied as long as the participation constraint of the low type is at least satisfied; and there is no reason that a rational low type will prefer to consume the quantity that a high type would like to consume and be charged at the high type’s price. Treating the constraints at equality we have for constraint (1):

$$\lambda_L v(q_L) = \frac{P_L}{\rho}$$

And substituting this to constraint (4) we have:

$$\lambda_H v(q_H) - P_H = \lambda_H v(q_H) - P_H$$

Using the expressions for $P_L$ and $P_H$ in the restaurant’s objective function, we have:

$$\rho \left( \lambda_H v(q_H) - v(q_L) \right) + (1 - \rho) (\lambda_L v(q_L) - cq_L)$$

To determine the best response of the low type, we obtain the first-order derivative of the restaurant’s objective function with respect to $q_L$, which shows:

$$\lambda_L v'(q_L) = c + \frac{\rho(\lambda_H - \lambda_L) v'(q_L)}{1 - \rho}$$

From the above expression, it clearly shows that $\lambda_L v'(q_L) > c$, whereas $\lambda_H v'(q_L) = c$ in the full information case. Since $v(q)$ is a concave function, the asymmetric information case shows that the quantity marketed for the lower type is lower than if it would be in the case of a full information case. However for the high type, by taking the first-order derivative of the restaurant’s objective function with respect to $q_H$, we have:

$$\lambda_H v'(q_H) = c$$

From the above expression, it shows that the high type case is similar to that of a full information case. Upon determining values for the quantities that the consumer player will order, the restaurant will then determine the best response prices using the derived $P_L$ and $P_H$ terms.

**FINDINGS**

An interesting insight not discussed in the reference is that the marginal price per quantity is a function of: (1) the odds ratio, (2) difference in consumer type, (3) the marginal benefit of the low
type. We obtain this claim by taking the first-order derivative of the $P_L$ term with respect to quantity consumed by the low type:

$$\frac{dP_L}{dq_L} = \lambda_L v'(q_L)$$

which is equivalent to:

$$\frac{dP_L}{dq_L} = c + \frac{\rho(\lambda_H - \lambda_L)v'(q_L)}{1 - \rho}$$

And for the high type, the marginal price per quantity is just equal to the marginal cost of producing the quantity; we obtain this claim by taking the first-order derivative of the $P_H$ term with respect to quantity consumed by the high type:

$$\frac{dP_H}{dq_H} = \lambda_H v'(q_H)$$

Which is equivalent to:

$$\frac{dP_H}{dq_H} = c$$

Therefore we can conclude that:

$$\frac{dP_L}{dq_L} > \frac{dP_H}{dq_H}$$

or that the marginal price per quantity for the lower type will always be larger than that of the high type.

With the condition that the marginal price charged to lower type consumers is higher during asymmetric information, we now find that the Cibo strategy is consistent with theory. We see that the low type consumers suffer a high cost per noodle than the higher types do, with P 6.6429 per ribbon noodle for the La Familia option and only P 6.4146 per ribbon noodle for the single order.

**CONCLUSION**

Cibo was able to segment its market to restaurant patrons into the low and high type, where the low type patrons would tend to be more price-sensitive than the high type patron; and it implemented a price discrimination pricing strategy in order to extract all surplus from both types. Due to the adverse selection problem, where Cibo cannot determine the type of the patron immediately, Cibo offered the La Familia option for the low type which is, however, distorted product offering and resulted to a nonlinear pricing scheme. The reason for the distortion is to ensure that the high type will not deviate from their strategy and order the La Familia option, as well as to meet the incentive for the low type to continue patronizing Cibo. A feasibility study for this strategy could be undertaken to determine if the nonlinear pricing scheme does ensure that the positive profits are still being generated by Cibo by implementing this strategy.

**REFERENCES**

