DYNAMIC PRICING: THE FUTURE OF RETAIL BUSINESS

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Abstract

Dynamic pricing is a pricing strategy in which businesses set flexible prices for products or services based on current market demands. Businesses are able to change prices based on algorithms that take into account competitor pricing, supply and demand, and other external factors in the market. Dynamic pricing can be found in a wide variety of industries such as hospitality, travel, entertainment, and retail. The practice is spreading to physical retailers, which are installing electronic price displays and borrowing pricing models from e-retailers. The aim of dynamic pricing is to increase revenue and profit. Accordingly, the fundamental objective of this paper is to investigate effects of dynamic pricing in retail industry i.e. how demand responds to changes in price. This paper is dedicated to simulation models in terms of competition systems. Findings of this study should represent real-life situations, and provide a realistic way that leads to the maximum expected revenue and profit.

Key words: retailers, dynamic pricing, demand, revenue, profit

1. INTRODUCTION

Price is one of the instruments of marketing mix and should contribute to achieving company objectives. Pricing is one of the most important, but also one of the most sensitive questions, because sales and revenues of companies depend on it. Besides companies, price level is of interest to consumers, competition companies and society. Price is one of the main determinants in the consumer's choice of goods. The importance of price in the consumer's choice depends on the goods offered and the consumer themselves. Some consumers always attach great importance to price, regardless of the type of goods they're buying. This is still true with poorer nations, among poorer groups, and with commodity-type products (Kolter, 1988, p.495).

Consumers, affected by the crisis, have recently become suspicious and wary of buying and more attentive to the value given for their money. They are much more prone to consolidation of their purchases and searching for cheaper products (Anic, 2010, p.145). Prices are also closely monitored and products with discount are bought more often, and this increases the importance of retail prices and favours the development of retail businesses focused on price. To attract consumers, retail prices are reduced, discount sales are more often and consumers are promptly noticed when they occur. Consumers' tendency to buy the product with discount compels manufacturers to cooperate more closely with retailers and to establish the common policy of pricing. This particularly refers to the policy of price cuts - their time, duration and the amount, but also to decisions about carrying the burden of reduced prices. All this often results in strong price competition between manufacturers and between retail businesses, which always tend to offer as many exclusive products with discount as possible. Manufacturers are very often at disadvantage and must accept the dictate of trading companies. Certain products (oil, coffee) in Croatia are sold with discount so often that their retail prices are actually dynamic.

2. THOERETICAL BACKGROUND AND RESEARCH PROBLEMS

Asking prices are based on calculation and consist of production costs (procurement costs) and remainder to the retail price. The lowest limit is determined by the cost of production (procurement cost) magnified for the cost of sale, while the upper limit is determined by the market. The market price is either higher or lower than the asking price, and if the operating costs are not covered, losses are inevitable. Price is a result of market laws. Due to the development of information technology and information systems within and between enterprises, the price has become extremely important and a more dynamic variable in the marketing mix.

The formation of price should be based on the following principles (Barković et al., 1986, pp. 154-155): 1) prices must be affordable for consumers, 2) prices must ensure expanded reproduction of companies, 3) prices must ensure an increasing volume of sales, and an increase in market share, 4) prices must be competitive, 5) prices must be in the function of stabilizing markets and 6) prices must reflect an appropriate rate of return.

The formation of price should also take into account particular factors (Barković, et al., 1986, p. 156): 1) the level and structure of the product's cost price, 2) the general market situation and characteristics of the market, 3) conjunctural movements and absorption power of the market, 4) elasticity of demand, 5) company goals, 6) the existence of competition and awareness of their prices, 7) sale channels and distribution modes, 8) value and quality of products, 9) position of the product on the curve of its life cycle, 10) differentiation of products in the manufacturing (retail) program, 11) features of consumer segments, 12) relation of prices and other instruments in the marketing mix, 13) other factors.

The objectives of the pricing policy are derived from the basic goals of the company. According to Kotler (1988, p. 497), there are six major business objectives that a company can pursue through its pricing: survival, maximum current profit, maximum current revenue, maximum sales growth, maximum market skimming, and product-quality leadership.

Modern commercial enterprises in accordance with the set obj ectives and factors that affect pricing, lead an active pricing policy. There are several types of active pricing policy (Benic, 1990, p. 147): one price policy, policy of price differentiation, price line, prices with promotional character, psychological prices, discount policy, a common policy of manufacturing and trading companies and price reductions. In practice, commercial enterprises, to the detriment of producers, now dictate the policy of minimum prices, discount sales, competitive prices and permanently low prices.

The policy of dynamic pricing is of recent date, and is better known in theory and practice as yield (or revenue) management. Its use dates back to the 1980s when

American Airlines's reservation system (called SABRE) allowed the airline to alter ticket prices, in real time and on any route, based on demand information. If it seemed that demand for expensive seats was low, more discounted seats were offered. If demand for full-fare seats was high, the number of discounted seats was reduced (Heizer & Render, 2004, p. 504). American Airlines's success and yield management encouraged many other companies and industries to adopt the concept.

Industries traditionally associated with revenue management operate in quadrant 2 of Figure 1.

Figure 1. Yield Management Matrix

		Price	
		Tend to be fixed	Tend to be variable
Duration of use	Predictable	Quadrant 1 Movies Stadiums/aremas Convention centers Hotel meeting space	Quadrant 2 **Hotels** **Airlines** **Rental cars** **Cruise lines**
	Unpreditable	Quadrant 3 Restaurants Golf courses Internet service providers	Quadrant 4 Continuing care hospitals

Source: Author prepared according to: Heizer, J. & Render, B. (2004): *Operations Management*, seventh edition, Prentice Hall., p.506

To make yield management efficient, the company needs to manage three issues (Heizer & Render, 2004, p. 507): 1) **multiple pricing structures** must be feasible and appear logical (and preferably fair) to the customer; 2) **forecasts of the use and duration of the use** and 3) **changes in demand**.

Businesses have always offered different prices to different groups of customers. They offer “matinée specials” for afternoon cinema-goers or “happy hours” for early-evening drinkers. They offer steep discounts to students or pensioners. Some put the same product into more than one type of packaging, each marketed to a different income group. Dynamic pricing takes all this to a new level—changing prices by the minute and sometimes tailoring them to whatever is known about the income, location and spending history of individual buyers.

Dynamic pricing is becoming one of the fundamental pricing policies as e-commerce develops. The oldest form of dynamic pricing is still seen today in outdoor markets. Sellers set the prices in the morning before customers arrive, and then during the day the prices are changed (usually lowered) depending on demand. The next day a new starting price is set and the whole process starts anew.

The price of goods and services sold online can be varied constantly and effortlessly, in accordance with the numbers and characteristics of those making purchases, and factors such as the weather. Competitors can be monitored constantly, and their prices matched. Amazon updates its price list every ten minutes on average, based on data it is constantly collecting, according to Econsultancy, a research and consulting firm (The Economist, 2016).

The practice is spreading to physical retailers, which are installing electronic price displays and borrowing pricing models from e-retailers. Kohl's, with nearly 1,200 stores in America, now holds sales that last for hours rather than days, pinpointing the brief periods when discounts are most needed. Cintra, a Spanish infrastructure firm, has opened several toll roads in Texas that change prices every five minutes, to try to keep traffic moving at more than 50mph (80kph). Sports teams, concert organisers and even zookeepers have embraced dynamic pricing to exploit demand for hot tickets and stimulate appetite for unwanted ones (The Economist, 2016).

In order to make dynamic pricing policy successful, it is necessary to implement the following: 1) demand for products must be flexible regarding the price, 2) demand for products must be flexible and 3) revenues generated by lowered prices must be higher than manufacturing costs and sales of additional product units.

Effective implementation of dynamic pricing policy, which, in addition to the market flexibility include reaction from the competition, support the following three models: 1) cost-oriented model, 2) price volume model, 3) heuristic model (computer simulation).

3. RESEARCH RESULTS AND DISCUSSION

Total revenue of a company based on production and/or sale of a product is determined by the relation between its quantity and price. On assumption of the existing link between the quantity of a sold product and demand for that product, the total income can be expressed in the form $R = p \times q$, respectively

$$R = p \times f(p) \tag{1}$$

where R stands for the total revenue, p for price, f (p) for the function of demand of the product in question. Thus, the total revenue can be expressed as a function of price, wherein the function of the total revenue is defined for all values of price wi th the corresponding function of demand.

As for each function of demand the corresponding inverse function can be expressed in the form p = φ (q), the total revenue can be expressed as a function of the quantity of demand, ie

$$R=q\times \varphi(q) \tag{2}$$

Accordingly, examination of movement of total revenue, based on the known function of demand can be made with respect to the price of the observed product, as well as in relation to the movement of demand. That can be an alternative way of observing movements of the total revenue.

In order to research the movement of total revenue when function of demand is known, designating and testing marginal revenue is particularly important. Marginal revenue, which shows the increase in total revenue when there's an increase in price (demand) per unit, is examined and reported through the corresponding function of the marginal revenue. Assuming that the function of the total revenue is a continuous function of price (demand) in the interval (a, b), the function of marginal rev enue can be expressed in the form retracted from the function of total revenue (Backović & Vuleta, 2002, p. 32). If the total revenue is expressed as a function of price, or

$$R = p \times f(p)$$

function of the marginal revenue is $R' = \frac{dR}{dp}$

and if R=q× φ(q), marginal revenue is defined thus: $R' = \frac{dR}{dq}$.

When the mark of the first copy is identified, or the positivity (negativity) of the marginal revenues, changes in total revenue may be determined, and expressed as the change in price of the observed product. Thus

$\frac{dR}{dp} > 0$ total revenue grows when the price is increased

$\frac{dR}{dp} = 0$ extreme value (maximum) of the total revenue is examined

$\frac{dR}{dp} < 0$ total revenue drops when the price is increased.

In order to fully understand the impact of dynamic pricing on total revenues of trading and manufacturing companies, what follows is a practical example inspired by the situation of cooking oil in Croatian market. Let us assume that the demand in one segment of the market is defined in the form of the function

$$q=-975p+19300$$

After insertion of this function into the function of total revenue (1):

$R = p \times (-975p + 19300)$
$R = -975p^2 + 19300p$

Function of the marginal revenue is

$R' = -1950p + 19300$

Maximum total revenue is achieved when

$R' = 0$ i $R''<0$

Which in this example is conditioned by the following:

$-1950p + 19300 = 0$

That is

$1950p = 19300$
$p = 9{,}90$

Because $R'' = -1950$, the price $p = 9{,}90$ is the price by which the maximum total revenue would be achieved, and maximum is calculated by replacing this value in the function of total revenue, so that we get

$R_{max} = R(9{,}90) = -975(9{,}90)^2 + 19300 \times 9{,}90$
$R_{max} = 95510{,}26$

Retail trading company can accept the price prevailing in this market segment as a given price or to independently form a price of cooking oil in accordance with the estimated demand for it in the course of the next fifteen days at its own retail facilities. Daily demand for cooking oil in retail facilities is defined by the initial function in the following form:

$q_1=-8{,}5p+220$.

Each subsequent function is based on the previous function, while the parameter of the function shows a downward trend of 5.5.

$q_2=-8{,}5p+214{,}5$
$q_3=-8{,}5p+209$
...
$q_{15}=-8{,}5p+143$

Based on the function of demand the calculated price for the first day is 12.94 HRK, which would achieve the maximum total daily revenue of 1,423.53 HRK.

In accordance with the aforementioned, retail trading company is given three options: 1) to sell the oil at a price of 9.90 HRK which would achieve the maximum total revenue in a given market segment, 2) to sell at a price of 12.94 HRK which would achieve the maximum total daily revenue, 3) to implement the dynamic pricing policy with the aim of obtaining maximum total revenue at the end of a particular period. In addition to the total revenue, the following will take into consideration net income as well, achieved when the total income is reduced by the costs of stock, estimated at the amount of 0.35 HRK per one litre of cooking oil.

To examine all the three options, a problem solving model was set in the spreadsheet Excel (cf. Table 1).

Table 1. The problem of pricing which would achieve the maximum total revenue

	A	B	C	D	E	F
3	Initial Inventory			1500		
4	Demand Slope			8,5		
5	Demand Intercept for Day 1			220		
6	Salvage Value			$ -		
7	Inventory Cost			$ 0,35		
8	Intercept Trend			5,5		
9						
10	Week	Price	Intercept	Demand	Sales	End Inv
11	0					1500
12	1	$ -	220,0	220,0	0,0	1500,0
13	2	$ -	214,5	214,5	0,0	1500,0
14	3	$ -	209,0	209,0	0,0	1500,0
15	4	$ -	203,5	203,5	0,0	1500,0
16	5	$ -	198,0	198,0	0,0	1500,0
17	6	$ -	192,5	192,5	0,0	1500,0
18	7	$ -	187,0	187,0	0,0	1500,0
19	8	$ -	181,5	181,5	0,0	1500,0
20	9	$ -	176,0	176,0	0,0	1500,0
21	10	$ -	170,5	170,5	0,0	1500,0
22	11	$ -	165,0	165,0	0,0	1500,0
23	12	$ -	159,5	159,5	0,0	1500,0
24	13	$ -	154,0	154,0	0,0	1500,0
25	14	$ -	148,5	148,5	0,0	1500,0
26	15	$ -	143,0	143,0	0,0	1500,0
27						
28		Revenue from sales				$0,00
29		Inventory Cost				$0,00
30		Revenue from salvaged units				$0,00
31						
32		Net Profit				$0,00

Source: author

Table 1 is fed data on the initial inventory, function of demand for cooking oil in retail facility, costs of holding inventories and trending of parameter function (upper part of the table). Decision variables are the prices and quantities of sold oil. Total revenues, costs of stock and net revenue are shown in the lower part of the table.

The model defined in Solver is as follows:
Set Target Cell: K 32
Equal To: maximize
By Changing Cells: B 12: B 26; E 12: E 26
Subject to the Constrains:
Quantity of sold oil cannot exceed the demand. $E$12:$E$26 ≤ $D$12:$D$26
Quantity of sold oil cannot exceed the stock. $E$12:$E$26 ≤ $F$11:$D$25

Having thus formulated the model in the Solver Parameters, the button Solve calculates the value of decision variables in the address sequ ence B 12: B 26; E 12: E 26th Decision variables define optimal solutions to the problem, that is maximum total and net revenues. Table 2 shows the optimal solution to dynamic pricing using the MS Excel spreadsheet.

Table 2. The optimal solution to the problem of dynamic pricing

	A	B	C	D	E	F
3	Initial Inventory			1500		
4	Demand Slope			8,5		
5	Demand Intercept for Day 1			220		
6	Salvage Value			$ -		
7	Inventory Cost			$ 0,35		
8	Intercept Trend			5,5		
9						
10	Week	Price	Intercept	Demand	Sales	End Inv
11	0					1500
12	1	$ 10,63	220,0	129,7	129,7	1370,3
13	2	$ 10,48	214,5	125,4	125,4	1244,9
14	3	$ 10,33	209,0	121,2	121,2	1123,7
15	4	$ 10,18	203,5	116,9	116,9	1006,8
16	5	$ 10,03	198,0	112,7	112,7	894,1
17	6	$ 9,89	192,5	108,5	108,5	785,6
18	7	$ 9,74	187,0	104,2	104,2	681,3
19	8	$ 9,59	181,5	100,0	100,0	581,3
20	9	$ 9,44	176,0	95,8	95,8	485,6
21	10	$ 9,29	170,5	91,5	91,5	394,1
22	11	$ 9,14	165,0	87,3	87,3	306,8
23	12	$ 8,99	159,5	83,0	83,0	223,7
24	13	$ 8,85	154,0	78,8	78,8	144,9
25	14	$ 8,70	148,5	74,6	74,6	70,3
26	15	$ 8,55	143,0	70,3	70,3	0,0
27						
28		Revenue from sales				$14.558,58
29		Inventory Cost				$3.259,72
30		Revenue from salvaged units				$0,00
31						
32		Net Profit				$11.298,86

Source: author

Data in Table 2 shows that by using dynamic pricing the maximum total revenue from sale of oil is 14,558.58 HRK or maximum net income of 11,298.86 HRK. It is important to point out that thanks to dynamic pricing, all of the oil has been sold. To draw a valid conclusion, the result obtained in Table 2 will be compared with the results obtained when the retail facility chooses to sell at a price of 9.90 and 12.94 HRK (cf. Table 3). The method of calculation is the same, except that this model needed another constrains. In the first case it is B12: B26 = 9.90 and in the second one B12: B26 = 12.94.

Table 3. Comparison of results obtained by different pricing policies

Price	Total revenue	Stock costs	Net revenue	Stock status
9,90	14456,48	3247,30	11209,18	40
12,94	13880,09	4332,58	9547,51	427
Dynamic prices	14558,58	3259,73	11298,86	-

Source: author

Data in Table 4 shows that maximum total and net revenues and an emptied stock are achieved through dynamic pricing.

4. CONCLUSION

Dynamic pricing policy is a recent strategy and better known in both theory and practice as yield (or revenue) management. Industries traditionally associated with revenue management are hotels, airlines, car rental companies and cruise lines. They apply variable pricing for their products and control product's use or availability. A growing number of companies keep their prices in a constant state of flux—moving them up or down in response to an ever-shifting multitude of variables. The dynamic-pricing revolution provides plenty of benefits for businesses. Besides helping them even out the demand, it's easier to get more money out of wealthier customers.

Dynamic pricing is becoming one of the fundamental pricing policies through development of e-commerce. The practice is spreading to physical retailers, which are installing electronic price displays and borrowing pricing models from e-retailers.

In practice today, the lowest price policy is still dominating, as are discount sales, competitive pricing and permanently low pricing. Discount sales are common, and the use of dynamic pricing is on the rise. The practical example above proves that the maximum total and net revenues are achieved through dynamic pricing.

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