ELSEVIER

Economics Letters 54 (1997) 41–44

economics letters

Why are so many goods priced to end in nine? And why this practice hurts the producers

Kaushik Basu*

Department of Economics, Uris Hall, Cornell University, Ithaca, NY 14853, USA

Received 19 August 1996; accepted 19 November 1996

Abstract

The widespread phenomenon of goods being priced at D dollars and 99 cents is explained without abandoning the assumption of full rationality; and it is shown that as a consequence of such pricing it is the *producers* who are generally worse off.

Keywords: Consumer rationality; Marketing; Price perception; Pricing

JEL classification: D40; L10

1. The problem

Our local store is offering Women's Leggings for \$9.99, Men's Thermal Henleys for \$14.99 (these were, by the way, originally available for \$19.99), and Classic Fleece Sweatshirts for \$24.99. Pizza Hut has been kind and put a flyer in our mailbox with six coupons: 2 medium two-topping pizzas for \$10.99, 1 medium specialty pizza for \$8.99, Family Pairs (whatever that may be) for \$12.99 and three other variations for \$10.99, \$15.99 and \$10.99, respectively. When one moves on to more valuable items, the cents vanish but the parade of nine or near-nine endings continue. The latest *Ithaca Times* has an advertisement offering the following 7-day winter getaways to Florida: Orlando \$379, Ft. Lauderdale \$459, St. Petersberg (not the one with the Hermitage) \$489.

The question that this paper investigates is: Why is this so? Clearly it cannot be that demand conditions and marginal cost conditions are such that the standard neoclassical equilibrium price almost invariably *turns out* to be such as to end in nine. Providence surely has better things to do.

Confronted with similar pricing dilemmas, economists have resorted to two different lines of explanation. One which appeals to 'psychological illusions' in consumers (see, for example, Monroe, 1990); and the other (usually, deductively more sophisticated) 'economic explanation', which somehow explains the phenomenon in question without relenting on the assumption of perfect rationality. Thus, for instance, consider the fact of periodic and regular sales or price mark-downs that

*Fax: +1 607-255-2818; e-mail: kb40@cornell.edu

PII S0165-1765(97)00009-8

shops indulge in. The 'psychological' explanation would resort to arguments like how consumers judge quality by looking at the original price tag on a good and so are more prone to buy an item that is marked down than one which has always been at the same price. We now know, however (see, for example, Varian, 1985; Sobel, 1984) that the same phenomenon can be given an economic explanation in terms of search costs or screening.

We return now to the question that this paper is concerned with. For brevity, it will be referred to as the phenomenon of 'pricing in the nines'. This is an old phenomenon, usually attributed to custom (Ginzberg, 1936). At first sight it seems that the only possible explanation for pricing in the nines is a psychological one. Consumers are busy and their brains have limited storage capacity; so it seems reasonable to suppose that they ignore looking at the last digits of a price. In other words, when they see something priced at D dollars and C cents, they treat this *as if* it cost D dollars (Nagle, 1987, pp. 248–249). Given such economizing of brain activity and space use, it makes sense for the producer to make the C as large as possible. Hence, the ubiquitous 99 cents. Consumers, according to this explanation, are systematically deluded.

I show that pricing in the nines has an economic explanation – one in which consumers are perfectly rational and not subject to any illusion. The economic explanation has a very interesting implication. In equilibrium it is the firms that are worse off because of this phenomenon. So, far from hurting the consumers (the equilibrium affect on whom is ambiguous), it is the firms that suffer as a consequence of pricing in the nines. Of course, this being an equilibrium, each firm is individually powerless to change the situation.

2. The solution

For simplicity assume that there are thousands of goods (we may distinguish between the same commodity sold at different locations) and for each good there is a market demand curve and each good is supplied by a monopolist. For good i, let the market demand function be

$$x_i = x_i((D_i, C_i)),$$

where (D_i, C_i) is the price of good i expressed in a somewhat unusual notation. D_i is the number dollars and C_i the number cents. Hence D_i is always a non-negative integer and $C_i \in \{0,1,\cdots,99\}$. Hence, if the price of good i is 5.75 dollars we shall say that its price is $(D_i, C_i) = (5,75)$.

It is best to think of us as looking at markets of relatively cheap goods, such that D_i will typically be less than a hundred dollars. If we were looking at more expensive goods, such as automobiles, then I would break up the price between thousands of dollars (T_i) and hundreds of dollars (H_i). Once the reader has understood my argument, translation to the domain of high-priced goods will be transparent and so I confine my attention to D_is and C_is.

It will be shown that under a plausible assumption about how consumers reason (which entails no compromise with the assumption of full rationality) producers will invariably set $C_i = 99$ and they will be worse off as a consequence. The argument of this paper being sufficiently straightforward, I do not resort to formalism. Also, instead of directly describing the final equilibrium, I describe a possible process leading up to the equilibrium, in the belief that such a method facilitates intuition.

Let us first assume that if consumers behave like textbook consumers, that is, given price (D_i, C_i)

they demand $x_i(D_i, C_i)$, then in sector i the monopolist's equilibrium price is (D_i^*, C_i^*). Let $\phi(\cdot)$ be the frequency distribution of the C_i^*s over $\{0,1,\cdots, 99\}$. That is, for each $C \in \{0,1,\cdots, 99\}$, $\phi(C)$ is the number of goods for which the price ends in C cents. More formally,

$$\phi(C) = \#\{i | C_i^* = C\}.$$

It seems reasonable to assume that $\phi(C)$ will be a uniform distribution on $\{0,1,\cdots, 99\}$. No such assumption is however necessary here.

We will simply assume that consumers, through browsing and the unwitting collection of information, know the distribution $\phi(C)$ that prevails on the market. Being busy, they economize on their brain function as follows. Let the expected value of C be EC. That is, $EC \equiv \Sigma C\phi(C)/\Sigma\phi(C)$. Suppose a consumer has to decide on how many units of good i to purchase. She will, it is being assumed here, not waste effort looking at C_i^*. She simply looks at D_i^* and assumes that C_i^* is the expected value, that is, EC. On average, she will be right and given some cost to the use of the brain, this could be a perfectly rational way of thinking.

We could go a step further and assume that consumer expectation of C is conditional upon the observed value of D. This will leave the analysis unchanged. Note that I am accepting the view that consumers process prices from left to right but, unlike in the standard marketing literature, I am assuming that what consumers expect for the last digits of a price is fully rational.

If consumers behave as described above, and good i is priced at (D_i^*, C_i^*), then the demand for good i will be $x_i((D_i^*, EC))$. Assuming that there are lots of firms and the effect on EC of a single firm changing its C_i is negligible, it follows that for each firm the optimal C_i to choose is 99.

Hence, each firm i chooses price equal to $(\hat{D}_i, 99)$ where $(\hat{D}_i, 99)$ gives the firm at least as much profit as $(D_i, 99)$, for all non-negative integers D_i. Hence, the final equilibrium price profile that prevails in the market is $\{(\hat{D}_i, 99)\}_{i=1,2,\cdots}$.

Observe that consumers, being rational, the demand for good i in equilibrium is given by $x_i((\hat{D}_i, 99))$. There is no psychological illusion. When buying good i, consumers still look only at $\hat{D}_i$ and simply presume that $\hat{C}_i$ takes its expected value, 99. And indeed $\hat{C}_i$ is 99.

But note that barring some coincidental cases these firms do worse than firms in textbook models. To see this note that if a single firm, i, deviates from $(\hat{D}_i, 99)$ and prices its product at $(\hat{D}_i, C_i)$ where $C_i < 99$, then demand will still remain at $x_i(\hat{D}_i, 99)$ since consumers assume $C_i = EC$. If, on the other hand, the firm changes the price to $(\hat{D}_i - 1, 99)$, then demand changes to $x_i(\hat{D}_i - 1, 99)$. And this, by the definition of $\hat{D}_i$, we know is not worthwhile. In other words, in equilibrium, each firm, effectively, faces a step-wise demand function which is to the left of the real demand function $x_i(D_i, C_i)$. Hence, it generically does worse than it would if it had faced the real demand function.

It is worth noting that, in the final equilibrium, the expectation of the consumer that a good which is priced at D dollars and some cents is actually priced at D dollars and 99 cents turns out to be exactly right.

3. Conclusion

This paper does not prove that the psychological explanation is wrong. It merely provides an economic explanation for a phenomenon for which this is not the first explanation that springs to mind

and, indeed, the 'evidence' of psychological illusion seems to be all too transparent. It is therefore interesting to see that what seems so transparent is not *necessarily* true and that there is a competing explanation which does not have to sacrifice the assumption of perfect rationality on the part of the consumer. To check whether psychological explanations play a role in industrial strategy and pricing, one would have to go beyond the phenomenon of pricing in the nines and devise subtle empirical tests and perhaps even do experiments. Such tests can only enrich our models of industrial organization and pricing.

Acknowledgments

I have benefited from discussions with Abhijit Banerji and Ernst Fehr.

References

Ginzberg, E., 1936, Customary prices, American Economic Review 26, 296.
Monroe, K.B., 1990, Pricing: Making profitable decisions, 2nd edn. (McGraw-Hill, New York).
Nagle, T.T., 1987, The strategy and tactics of pricing (Prentice Hall, Englewood Cliffs, NJ).
Sobel, J., 1984, The timing of sales, Review of Economic Studies 51, 353–368.
Varian, H., 1985, Price discrimination and social welfare, American Economic Review 75, 870–875.