

# Incumbent Behavior in Vertically Differentiated Markets with Bounded Rational Consumers\*

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## Abstract

Researchers have hitherto modeled incumbents as entities who resort to strategies to keep entrants off the market with a few exceptions that present an interesting case wherein an incumbent firm is better off with the entry of another identical firm. We extend that research for entrants that offers a sufficiently different (higher or lower) quality of the product manufactured by our incumbent. While these results can be primarily explained by market coverage, the results are remarkably stronger when we introduce reference dependent consumers. In our two-product market, consumers consider the high quality product as their reference point, against which they evaluate the low quality product. Firms account for this aspect of consumer behavior. We conclude that the presence of reference dependence reduces price sensitivity and softens price competition. This paper gives a new reason for why an incumbent might want to invite entrant and concludes that sufficient quality differential (capturing entire market) will guarantee the same.

**Keywords** : Vertical Product Differentiation, Price Competition, Reference Dependence.

**JEL Classification** : D11, D43, L11, L13.

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# 1 Introduction

We present a benchmark case with an incumbent monopoly and then introduce a high quality (product manufacturing) firm. We show that if the quality differential between both the firms is sufficiently large then the lower quality firm benefits from the presence of the higher quality firm. Similarly, we also show that a high quality monopoly will benefit from the presence of a low quality entrant.

We present our primary results in the setting of a vertically differentiated duopoly producing  $s_i$  ( $i = 1, 2$ ) quality products with reference dependent consumers. Consumers consider the high quality product as their reference product. They derive some intrinsic utility from the consumption of the (low-quality) product and some loss in the utility due to comparison with the better product. This comparison effect is not there when he consumes the high quality product. Our assumption of considering the high quality product as the reference point can be explained in the words of Garcia et al. (2013), according to whom, "people commonly seek to achieve a superior position vis-à-vis others in a variety of contexts, from daily social situations to organizational settings and market transactions." This explains why the 'superior' becomes the reference point, since the role of individual and situational factors often increase social comparison concerns, and thus competitiveness. This sums up the idea of the 'unidirectional drive upward'. In our framework, we show that reference dependence softens price competition enabling both the firms to charge higher prices than no reference dependence case. Finally, we also show that reference dependence enhances the effect of market coverage on the profit differential between a duopoly and monopoly.

In economics, general insight suggests that an increase in competition lowers the price and the profit. However, in real life there are various instance where a monopoly is taken over by duopoly with considerable increase in profit. Many empirical studies have raised this possibility where incumbant might welcome entrant. In the anti-ulcer drug market it has been found that the entry of a new firm raises the prices (Perloff et al. (2005)). Similarly, in the food industry introduction of private labels increased the prices of national labels (Ward et al. (2002) and Thomadsen (2007)). Economists have always tried to find out the theoretical explanation for such a behavior. One of the first ideas proposing this possibility found that the incumbant might be less agresive if the entrant limits its capacity (Gelman and Salop (1983)) or may give entrant the license to the technology to reduce the incentive of the entrant to develop a new tachnology (Gallini (1984)). In this paper, we give theoretical reason for prices and profits to increase with increase in competition. We derive some sufficient conditions under which profits are higher for duopoly than monopoly; and, we show that this sufficient condition can be relaxed if consumers exhibit greater reference

dependence.

There is substantial research on the effect of reference points. As defined by Spiegel (2011) a reference point is "an action or a consequence (or some aspect of either) which acts as a 'frame' of a choice problem and affects choices in a way that is ruled out by conventionally rational decision making." The idea that people see things in context is manifested in the effects of default options (amounting to the singling out of a feasible alternative as in Park et al. (2000) and Johnson et al. (2002) among others), historical values (particularly in the context of consumer experience in dynamic choice under uncertainty as in Klein and Oglethorpe (1987)), expectations (in response to the realization of an exogenous uncertain effect as in Song (2012)), and anchoring (which exerts a 'pull' on the decision makers' judgement as in Chapman and Johnson (1999), Strack and Mussweiler (1997), and Mussweiler and Strack (1999)) in agent behavior. Such effects of references on consumer preference have been extensively observed in laboratory experiments. More extreme cases of reference dependence leading to preference instability have been reported in Samuelson and Zeckhauser (1988), and Huber et al. (1982) where the choice between two bundles is reversed by the introduction of reference bundles, and in Shampanier et al. (2007), where such a reversal is due to a reference price (zero). Reference dependence is also known to cause differences between willingness to pay and willingness to accept (see Thaler (1980), Kahneman et al. (1990); and Carmon and Ariely (2000)).

In the area of consumer behavior, many experiments have demonstrated that the earlier constructs of choice and preference theories are not complete and need to be enriched further. Various axiomatic (see Tversky and Kahneman (1991); Ok, Ortoleva, and Riella (2012); and Masatlioglu and Ok (2005), for an analysis on determination of choices over non-risky alternatives) and non axiomatic models (see Köszegi and Rabin (2006)) have been proposed to incorporate interesting aspects of reference dependence that qualify as anomalous to the earlier constructs. Reference points for example, are context dependent. While Spiegel (2012) takes consumers to treat sample prices as their references, Heidhues and Köszegi (2008), and Karle and Peitz (2012) model consumers to take rational expectation-based reference points.

We have so far, discussed the issue of reference dependence in relation to consumer behavior. The impact of references has also been studied in many areas such as the choice over risky alternatives (Wedell (1991) and Herne (1997)), choice of job candidates (Highhouse (1996), Slaughter, Sinar and Highhouse (1999)); auctions (Ariely and Simonson (2003)) and so on.

Our research focuses on the implication of reference-dependent consumer behavior on firm strategy. The previous work comprises the works of Heidhues and Kozegi (2014), and

Speigler (2012), who (among others) investigated the impact of expected prices as reference points on monopoly pricing; and those like Zhou (2011), that analyse the effect of reference dependence on firm’s pricing and advertising strategy in a horizontally product differentiated duopoly.

In this paper, we will examine a vertically differentiated duopoly where consumer exhibit reference dependence. In such a scenario, we analyse the implication of this consumer behavior on the equilibrium prices, welfare and the market structure.

The rest of the paper is organized as follows. Section 2 presents the motivation for this interesting research, coming from the Indian tuition markets. Section 3 discusses the benchmark case of the monopoly. Section 4 presents the duopoly model which is analysed in section 4. Section 5 analyses welfare implications. Section 6 concludes and discusses further possible extensions of the model.

## 2 A Motivation

In a country like India where a career in engineering is much sought after, the advent of tuition centers becomes unquestionable. What is interesting is that the ranking of all these tuition centers are unanimous i.e. for any two centers, if one is preferred to another by a given individual then it is true for every other individual. In other words, the ranking (which is a measure of the quality of the center) between the tuition centers is common knowledge. I show that in such markets with consumer experience loss due to reference dependence in the product dimension softens competition such that both the lower quality firm and the high quality firm raise their prices. In this paper I present a model of complete information that explains the above story. The findings employ the models of consumer behaviour that account for reference dependence.

## 3 The Benchmark Case: Monopoly

Consider the case when low quality ( $s_1$ ) producing firm is the monopolist in the market. A consumers preference is as follows

$$U = \begin{cases} \theta s_1 - p_1 & \text{if he buys the good} \\ 0 & \text{otherwise} \end{cases}$$

where  $\theta$  represents the taste parameter of the consumer. For a given quality, a consumer with high  $\theta$  is willing to more than a consumer with low  $\theta$ . We assume that  $\theta \sim U[\underline{\theta}, \bar{\theta}]$ . The consumer who is indifferent between buying and not buying from the low quality monopolist

is of the type  $\hat{\theta}$ , such that  $\hat{\theta}s_1 - p_1 = 0$ , so that  $p_1 = \hat{\theta}s_1$ . Thus the demand faced by this firm will be  $\bar{\theta} - \hat{\theta}$ , and the profits equal  $p_1(\bar{\theta} - \hat{\theta}) = \hat{\theta}s_1(\bar{\theta} - \hat{\theta})$ , maximizing which, with respect to  $\hat{\theta}$ , gives us the solution  $\hat{\theta} = \bar{\theta}/2$ , and  $p_1 = \bar{\theta}s_1/2$ , at which the profits equal  $\bar{\theta}^2 s_1/4$ . Similarly, if the high quality firm was the monopolist then its profit was given by  $\bar{\theta}^2 s_2/4$ .

## 4 A Model of Perfect Information : Duopoly

Two firms (1 and 2) sell a single product of distinct quality  $s_i$  (where  $i = 1, 2$ ). Quality is given exogenously such that  $s_1 < s_2$ . For every consumer the higher quality ( $s_2$ ) product is preferred over lower quality product ( $s_1$ ). Thus, the products are vertically differentiated i.e. all consumers unanimously prefer one product over the other. However, consumers are heterogeneous in the way they value quality, represented by  $\theta$ . We assume that  $\theta \sim U[\underline{\theta}, \bar{\theta}]$ , with  $\bar{\theta} \geq 2\underline{\theta}$  (so that a minimum consumer heterogeneity is guaranteed), and  $\bar{\theta} = 1 + \underline{\theta}$ . A consumer with higher  $\theta$  values quality improvements more strongly. Each consumer has unit demand for the product in question, which is manufactured at a unit cost which we normalize to zero. Firms set prices simultaneously. The analysis that we present here is based on the models initially developed by Gabszewicz and Thisse (1979) and Shaked and Sutton (1982).

When a consumer with the taste parameter  $\theta$  consumes quality  $s_i$  for price  $p_i$ , she gets an intrinsic utility of  $\theta s_i - p_i$ . In general, consumers also exhibit reference dependent preferences. There is a tendency to compare, evaluate products and feel loss or gain depending on whether they get lower or higher than their reference levels. We assume that the consumer takes the high quality firm's product (more specifically, the utility derived from it) as a reference point. Two questions arise here:

1. Why should the high quality product serve as a reference point?
2. Why should consumers compare utilities derived from the consumption of goods and not something else?

The first question above can be addressed in the words of Garcia et al. (2013), according to whom, "people commonly seek to achieve a superior position vis-à-vis others in a variety of contexts, from daily social situations to organizational settings and market transactions." This explains why the 'superior' becomes the reference point, since the role of individual and situational factors often increase social comparison concerns, and thus competitiveness. This sums up the idea of the 'unidirectional drive upward'. Further, in Zhou (2011) the prominent firms' product becomes the reference point and prominence comes from advertising. In our

model, ranking provided by experts, act as a source of prominence which is considered more reliable than advertisement, for the latter only focuses on the positive aspects of the product. The second question above can be answered in the context of Koszegi and Rabin (2006) who argue that an approach that explicitly incorporates consumption utility into the analysis is clearly more complete in terms of both behavior and welfare than formulations with single “value functions” that evaluate gains and losses relative to a reference point, and ignore or suppress the role of consumption utility in the evaluation of outcomes.<sup>1</sup>

The utility of consumer with  $\theta$  as her taste parameter, from consuming  $s_2$  at price  $p_2$  is given by:

$$U = \theta s_2 - p_2 \tag{1}$$

The utility of consumer with  $\theta$  as her taste parameter, from consuming  $s_1$  at price  $p_1$  is given by:

$$U = \theta s_1 - p_1 - \lambda(\theta s_2 - \theta s_1) \tag{2}$$

Here, the first two terms on the right hand side represent the intrinsic utility from product 1 and the last term captures loss in utility due to reference dependence (since product 2 acts as a reference point for product 1).  $\lambda > 0$  is the reference dependence parameter which captures the strength of reference dependence effect. If  $\lambda = 0$  then there is no reference dependence effect and we get back the standard vertical product differentiation model. The above (reference dependent) utility function has yet another interesting interpretation. We can argue that given reference level quality ( $s_2$ ) the consumer with a higher taste for quality (i.e. higher  $\theta$ ) will experience a larger loss than a consumer with a lower  $\theta$ . This feature is captured by the interaction of  $\theta$  with  $(s_2 - s_1)$ . Thus the impact of reference dependence for our consumer is magnified by  $\theta$ .

## 4.1 Demand

Whether a consumer with  $\theta$  as her taste parameter will buy from firm 1 or firm 2 is just a matter of utility comparison. Let us denote the indifferent consumer with the type  $\hat{\theta}$ . Then all the consumers with  $\theta \leq \hat{\theta}$  will buy the low quality product and all those with  $\theta \geq \hat{\theta}$  will

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<sup>1</sup>Koszegi and Rabin (2006) consider a hypothetical experiment in which a consumer is endowed with 100 paper clips and 100 \$10 bills as part of her reference point, and must choose between two gambles: a 50-50 chance of gaining a paper clip or losing a paper clip, and the comparable gamble involving \$10 bills. It seems likely that she would risk losing the paper clip rather than the money, and do so because her sensation of gains and losses is generally likely to be smaller for a good whose consumption utility is smaller.

buy the high quality product. The indifferent consumer satisfies

$$\theta s_1 - p_1 - \lambda(\theta s_2 - \theta s_1) = \theta s_2 - p_2$$

and his type is given by

$$\hat{\theta} = \frac{p_2 - p_1}{(s_2 - s_1)(1 + \lambda)} \quad (3)$$

Thus, the demand that Firm 1 faces is

$$D_1(p_1, p_2) = \hat{\theta} - \underline{\theta} = \frac{p_2 - p_1}{(s_2 - s_1)(1 + \lambda)} - \underline{\theta} \quad (4)$$

and the demand that Firm 2 faces is

$$D_2(p_1, p_2) = \bar{\theta} - \hat{\theta} = \bar{\theta} - \frac{p_2 - p_1}{(s_2 - s_1)(1 + \lambda)} \quad (5)$$

A rise in consumers' loss due to reference dependence  $\lambda$  raises the demand for product 2 and reduces that of product 1. The profit functions of the firms are:

$$\pi_1(p_1, p_2) = p_1 \left( \frac{p_2 - p_1}{(s_2 - s_1)(1 + \lambda)} - \underline{\theta} \right) \quad (6)$$

$$\pi_2(p_1, p_2) = p_2 \left( \bar{\theta} - \frac{p_2 - p_1}{(s_2 - s_1)(1 + \lambda)} \right) \quad (7)$$

The first order condition (FOC) for each firm (as shown below) involves the equality of its marginal profit (conditional on the other firm's price), to its own marginal cost (equal to zero in our model).

$$\frac{\partial \pi_1}{\partial p_1} = \frac{p_2 - 2p_1}{(s_2 - s_1)(1 + \lambda)} - \underline{\theta} = 0$$

$$\frac{\partial \pi_2}{\partial p_2} = \bar{\theta} - \frac{2p_2 - p_1}{(s_2 - s_1)(1 + \lambda)} = 0$$

The reaction functions are

$$p_1(p_2) = \frac{p_2}{2} - \frac{\underline{\theta}(s_2 - s_1)(1 + \lambda)}{2} \quad (8)$$

$$p_2(p_1) = \frac{p_1}{2} + \frac{\bar{\theta}(s_2 - s_1)(1 + \lambda)}{2} \quad (9)$$

It is clear that each firm would want to raise its price when the other does since the loss in profits due to a corresponding reduction in demand (relative to the demand level at the

firm's initial price given that the other firm has raised its price) is more than compensated by the rise in price. In other words, prices are strategic compliments. Additionally, we require the following assumption to ensure full market coverage in equilibrium

$$\frac{(s_2 - s_1)((\bar{\theta} - 2\underline{\theta}) + (\bar{\theta} + \underline{\theta})\lambda)}{3} \leq \underline{\theta}s_1$$

In the equilibrium, the prices depend on the quality and reference dependence parameter  $\lambda$ .

$$p_1^* = \frac{(\bar{\theta} - 2\underline{\theta})(s_2 - s_1)(1 + \lambda)}{3} \quad (10)$$

$$p_2^* = \frac{(2\bar{\theta} - \underline{\theta})(s_2 - s_1)(1 + \lambda)}{3} \quad (11)$$

**Proposition 1** *When  $2 \leq \frac{\bar{\theta}}{\underline{\theta}} \leq \frac{2 - \lambda}{1 + \lambda} + \frac{3s_1}{(s_2 - s_1)(1 + \lambda)}$ , both firms' prices and profits are increasing in  $\lambda$ .*

This condition  $2 \leq \frac{\bar{\theta}}{\underline{\theta}} \leq \frac{2 - \lambda}{1 + \lambda} + \frac{3s_1}{(s_2 - s_1)(1 + \lambda)}$  ensures that there is sufficient level of consumer heterogeneity to support equilibrium outcome and full market coverage. It is not surprising to observe that the price of the high quality firm is increasing in  $\lambda$ . A high  $\lambda$  corresponds to more loss and therefore less tolerance towards the consumption of good 1 in the presence of the higher quality product 2. This (relatively) high demand makes it advantageous for firm 2 to charge a higher price. Therefore, price charged by firm 2 increases in  $\lambda$ . And since the reaction function of firm 1 responds positively to the price charged by firm 2, a high  $\lambda$  is (indirectly) associated with a high  $p_1$ . A rise in  $p_1$  is perhaps more surprising as demand for firm 1 falls with a high  $\lambda$ . Intuitively, it can be seen that firm 2 rely more on the consumers with high level of  $\theta$ , which softens the competition between both the firms. This results in an increase in profits with  $\lambda$ . Both  $p_1$  and  $p_2$  are increasing in the quality differential. An increase in quality differential increases the market power of the firm by relaxing competition which leads to increase in prices charged by the high quality firm.<sup>2</sup>

$$p_2 - p_1 = \frac{(\bar{\theta} + \underline{\theta})(s_2 - s_1)(1 + \lambda)}{3} \quad (12)$$

An interesting result is that the price differential itself is increasing in  $\lambda$ . Therefore, it must be the case that the increase in  $p_2$  is more than the increase in  $p_1$ . The equilibrium

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<sup>2</sup>What demands attention here is the role that  $\theta$  plays in determining the relation between  $\lambda$  and  $p_1$ .



profits are

$$\pi_1(p_1^*, p_2^*) = \frac{(\bar{\theta} - 2\underline{\theta})^2 (s_2 - s_1)(1 + \lambda)}{9} \quad (13)$$

$$\pi_2(p_1^*, p_2^*) = \frac{(2\bar{\theta} - \underline{\theta})^2 (s_2 - s_1)(1 + \lambda)}{9} \quad (14)$$

We immediately see that both firms' profits are increasing in the reference dependence parameter  $\lambda$ .

## 4.2 Analysis with a general reference dependence function

Let us consider a more general reference dependence function  $f(\lambda\Delta s)$ , where  $\Delta s = (s_2 - s_1)$ .

We assume that  $f(\cdot)$  satisfies the following properties

1.  $f(\cdot)$  is twice differentiable
2.  $f' > 0$
3.  $f(0) = 0$

Assumption 2 captures a simple aspect that an increase in the reference dependence parameter or that in the quality differential will lead to an increase in the disutility due to reference dependence. Zero reference dependence cases are captured by assumption 3.

The utility of consumer of type  $\theta$  from consuming good 1 is

$$U = \theta s_1 - p_1 - \theta f(\lambda, \Delta s) \quad (15)$$

The utility from good 2 remains same, as stated above. The consumer type  $\hat{\theta}$  who is indifferent between consuming good 1 or 2 is

$$\hat{\theta} = \frac{(p_2 - p_1)}{(\Delta s + f(\lambda, \Delta s))} \quad (16)$$

An increase in  $\lambda$  shifts  $\hat{\theta}$  to the left, reducing the demand of firm 1. Intuitively, the earlier indifferent consumer gets more disutility from the difference between the two product qualities. Hence, she must switch to good 2 which reduces the demand for good 1. The profit functions are

$$\pi_1(p_1, p_2) = p_1 \left( \frac{p_2 - p_1}{\Delta s + f(\lambda, \Delta s)} - \underline{\theta} \right)$$

$$\pi_2(p_1, p_2) = p_2 \left( \bar{\theta} - \frac{p_2 - p_1}{\Delta s + f(\lambda, \Delta s)} \right)$$

The reaction functions are

$$p_1(p_2) = \frac{p_2}{2} - \frac{\theta(\Delta s + f(\lambda, \Delta s))}{2}$$

$$p_2(p_1) = \frac{p_1}{2} + \frac{\bar{\theta}(\Delta s + f(\lambda, \Delta s))}{2}$$

The equilibrium prices are

$$p_1^* = \frac{(\bar{\theta} - 2\theta)(\Delta s + f(\lambda, \Delta s))}{3} \quad (17)$$

$$p_2^* = \frac{(2\bar{\theta} - \theta)(\Delta s + f(\lambda, \Delta s))}{3} \quad (18)$$

Here again, as long as the reference dependence function satisfies the above mentioned properties the prices of both firm will increase in  $\lambda$ . So, the results go through as long as  $\theta$  enters multiplicatively with  $\lambda\Delta s$ .

### 4.3 Monopoly versus duopoly

Comparing the profits of both the firms under monopoly and duopoly cases, we find that both firms in the incumbant role would welcome the entrant. The dominance of duopoly over monopoly is an interesting result. Generally, in the existing literature on price discrimination monopoly profits are greater than duopoly profit since the monopolist can always choose output produced in the duopoly. However, in this model, the monopolist cannot capture the benefits arising from the quality differential and the disutility experienced by consumers (in the case of duopoly). It is also interesting to note that the higher the  $\lambda$ , the smaller will be the difference in the quality required to support the above result. Market coverage is still the primary factor that governs this results.

**Proposition 2** *If the quality differential is sufficiently large i.e.  $\frac{s_2}{s_1} \geq 1 + \frac{1}{1+\lambda} \left[ \frac{3}{2} \left( \frac{1+\theta}{1-\theta} \right) \right]^2$ , then monopoly profits for both the lower quality and the higher quality firm will be less than their profits under duopoly.*

## 5 Welfare Analysis

We define social welfare as the sum of profits of both firms and the consumers' surplus of those who consume good 1 and good 2. The social welfare denoted by  $W$  is given by

$$W = \pi_1 + \pi_2 + \int_{\underline{\theta}}^{\hat{\theta}} \left( \theta s_1 - \frac{(\bar{\theta} - 2\theta)(1 + \lambda)\Delta s}{3} - \lambda\theta\Delta s \right) d\theta + \int_{\hat{\theta}}^{\bar{\theta}} \left( \theta s_2 - \frac{(2\bar{\theta} - \theta)(1 + \lambda)\Delta s}{3} \right) d\theta \quad (19)$$

It's easy to see that both individual and aggregate consumer welfare are decreasing in  $\lambda$ . As  $\lambda$  goes up, prices of both products go up and quality of product is exogenously. So, individual consumer becomes worse off. Moreover, in equilibrium  $\hat{\theta} = \frac{\bar{\theta} + \underline{\theta}}{3}$  is independent of  $\lambda$ . Hence, in equilibrium the cutoff remains unchanged leading to an aggregate decline in consumer welfare.

Using  $\hat{\theta} = \frac{\bar{\theta} + \underline{\theta}}{3}$  and differentiating  $W$  with respect to  $\lambda$  we get

$$\frac{\delta W}{\delta \lambda} = -\bar{\theta}^2 + 8\underline{\theta}^2 - 2\bar{\theta}\underline{\theta} \quad (20)$$

$$\frac{\delta W}{\delta \lambda} \leq 0 \text{ as } \bar{\theta} \geq 2\underline{\theta}.$$

**Proposition 3** *Consumer welfare and social welfare are decreasing with  $\lambda$ .*

More severe loss due to reference dependence will reduce price competition, enabling firms to charge higher prices and leaving the consumers worse off. It also leads to lower total welfare.

## 6 Conclusion

This paper contributes to the growing literature that tries to understand the implication of a particular consumer behavior on the functioning of market. This paper has analyzed the implication of consumer reference dependence on firms strategy and consumer welfare, in a vertically differentiated market. We have shown that prices and profits of both firms increase with greater reference dependence and consumer welfare decreases with greater reference dependence. So, the greater reference dependence will make consumers worse off. We also raise a possibility that under reference dependence, the profit of the lower quality firm in a vertically differentiated duopoly can be greater than that in monopoly, provided that the degree of differentiation is sufficiently high.

It will be interesting to extend this model to the 'n' product case, where the reference point for consumption will depend on a consideration set. It would also be desirable to

introduce uncertainty in the quality dimension i.e. consumers only know the product ranking and not the exact qualities. In general, it is hard to infer exact quality prior to purchase but there are several sources like expert ranking that helps consumers to rank products. So, ex ante it is possible to have some ranking of the products. Further, reference dependence may influence investment by firms on R&D, which in turn may affect the quality of products available.

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