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Advertising Costs and Product Prices

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Abstract

How does a change in the cost of advertising affect product prices? On the one hand, advertising increases costs, but on the other hand, advertising is expected to generate more sales, so the impact on product prices and profits depends on the magnitude of these two effects. In this article I describe some recent trends in online and offline advertising and build a simple model of an online merchant. In this model when advertising becomes more costly, the merchant cuts back on ad spending, but it does not necessarily change product prices.

1. Introduction

It has been claimed that online ad prices are higher than they would be in a more competitive environment and that these high ad prices can be passed through to increase product prices, which harms consumers. Here is an example from a Competition and Markets Authority ([CMA] 2020, para. 9) report: "The costs of digital advertising, which amount to around £14 billion in the UK in 2019, or £500 per household, are reflected in the prices of goods and services across the economy. These costs are likely to be higher than they would be in a more competitive market, and this will be felt in the prices that consumers pay for hotels, flights, consumer electronics, books, insurance and many other products that make heavy use of digital advertising" (see also CMA 2020, paras. 6.15, 6.19–6.21; app. P, para. 61; app. Q, para. 3; app. U, para. 78). Stripped down to its essentials, this paragraph says, "Other things being equal, an increase in ad costs will lead to an increase in product prices." If this is so, it is natural to expect that other things being equal, a decrease in ad costs will lead to a decrease in product prices.

As Peltzman (2000, p. 467) puts it, "In the paradigmatic price theory we teach, input price increases or decreases move marginal costs and then prices up or down symmetrically and reversibly." In other words, if an increase in the cost of some input pushes product prices up, then a decrease in the cost of that input should push product prices down, other things being equal.

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Figure 1. Online advertising price index

So have online ad costs increased or decreased in recent years? Figure 1 shows the Bureau of Labor Statistics price index for online advertising, which has generally decreased over the last 2 decades.[1] In June 2020 this pattern reversed, and the price index started to rise, mostly likely because of the COVID-19 pandemic.

Of course one still has to remain aware of the "other things being equal" qualification. It is possible that something other than the COVID-19 lockdown happened in spring 2020 that caused online ad prices to increase, but personally I deem this unlikely. The pass-through theory claims that an increase in ad cost gets passed along to product prices. Does a reduction in ad cost get passed along as well?

2. Trends in Advertising

2.1. Print and Digital Advertisements

In the last 2 decades, ad spending patterns have changed significantly. As Figure 2 shows, spending on print ads has declined, and spending on digital ads has increased, but the sum of the two has remained roughly constant, except for the 2007 drop due to the great recession.[2] As printed content moved online, ad spending followed.

[1] The data for Figure 1 are from Bureau of Labor Statistics, Producer Price Index by Commodity: Advertising Space and Time Sales: Internet Advertising Sales, Excluding Internet Advertising Sold by Print Publishers (WPU365) (https://fred.stlouisfed.org/series/WPU365), and Bureau of Labor Statistics (2009).

[2] The data for Figure 2 are from Nakamura, Samuels, and Soloveichik (2017). See also Chemi (2014) and Mandel (2019).

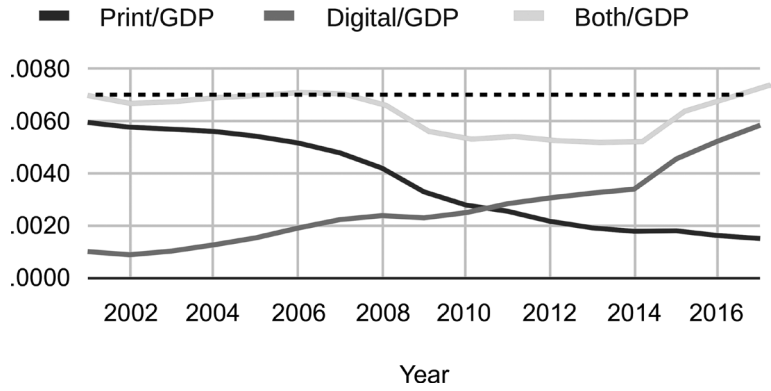

Figure 2. Ad expenditure as share of gross domestic product (GDP) by medium

2.2. Online and Offline Advertising

It is strange that the CMA refers only to the cost of digital advertising in the passage cited above. If expenditure on digital advertising is "reflected in the prices of goods and services," should this not also be true for offline advertising? In 2018 offline advertising was about a third of all ad spending in the United Kingdom (Fisher 2019), so this omission is hardly negligible.

As noted in Figure 2, much of the growth of online advertising in the last 20 years was due to advertisers shifting spending from print to online. In 1993 expenditure on print ads was about .61 percent of gross domestic product (GDP), while digital spending was 0. By 2017 print expenditure had fallen to .15 percent of GDP, and digital spending had risen to .58 percent of GDP, which made digital's share in 2017 about the same as print's share in 1993.

More can be learned from Figure 3, which shows nearly a century of ad spending by media type.[3] First, audiovisual ads (TV and radio) steadily increased until 2000, at which point they leveled out. Second, as already mentioned, print ad expenditure fell steadily during the same period when digital ad expenditure increased. As Nakamura (2016, p. 25) indicates, "Intuitively, prices for advertising-supported media have been rising much slower than overall GDP prices." Third, summing over the media types shows that total ad expenditure as a fraction of GDP has been roughly constant at around 1 percent, which suggests that advertising is a relatively small expenditure for most firms. Finally, it is clear that replacing a $10 million print ad campaign with a $10 million digital ad campaign does not have any effect on total ad expenditure. Even if ad costs can be passed through in some way, it is not relevant here since there is no net ad cost to pass through: the increased spending on digital ads is counterbalanced by decreased spending on print ads.

[3] The data for Figure 3 are from Nakamura, Samuels, and Soloveichik (2017).

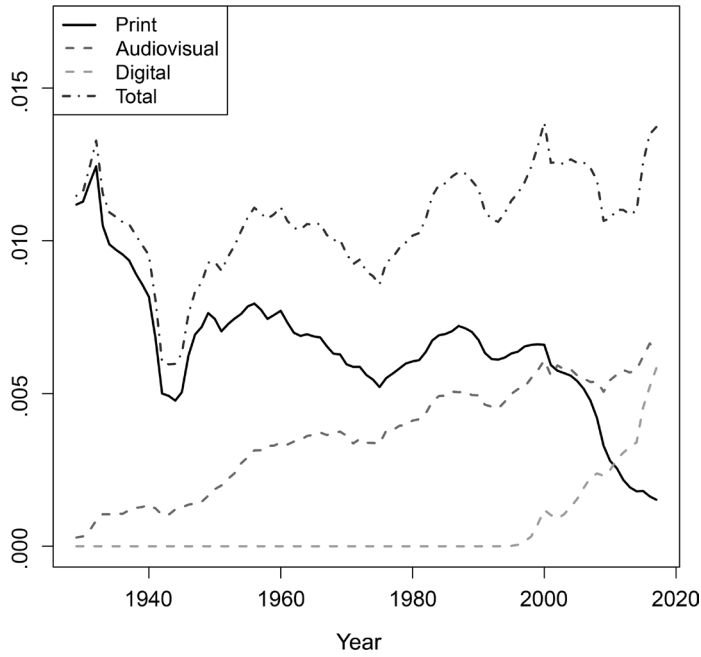

Figure 3. Ad spending by media type, normalized by gross domestic product

2.3. Product Prices

What about product prices? Recall that the CMA signaled specific industries in which it expected prices to increase if the cost of online advertising increased: hotels, flights, consumer electronics, books, and insurance. It turns out that none of these categories have seen prices rise more rapidly than the overall rate of inflation. Of course, it cannot be said that the observed decline in ad costs caused lower product prices since there were many other factors at work. For example, according to the Bureau of Labor Statistics (2015), the quality-adjusted price index for a TV decreased by a staggering 94 percent from December 1997 to August 2015. However, this cannot be attributed entirely to a change in online ad costs, since manufacturing costs changed significantly during this period.

What happens to prices for a broader sample of goods? Goolsbee and Klenow (2018) construct a digital price index (DPI) for categories of goods commonly sold online and compare it with the consumer price index (CPI). As shown in Figure 4, they find that both price indices declined over the last few years, with the DPI declining significantly more rapidly than the CPI. In sum, historically ad costs and product prices decreased over most of the last 2 decades, but both appeared to increase during the COVID-19 pandemic.

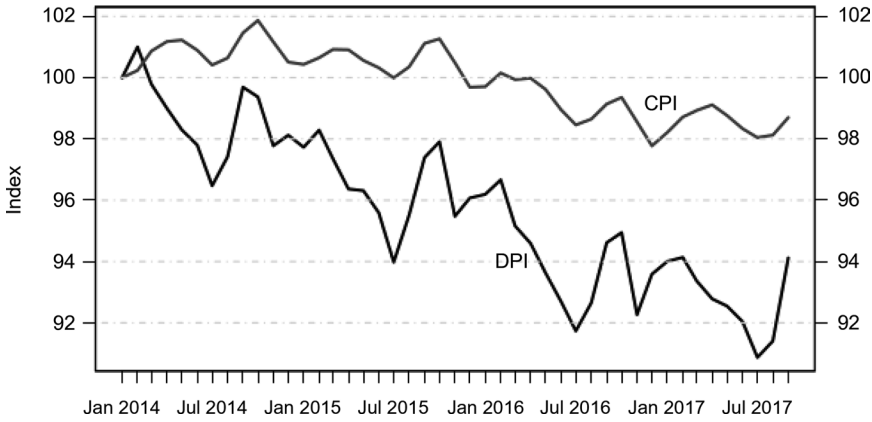

Figure 4. Cumulative inflation for consumer price index (CPI) and digital price index (DPI) (Goolsbee and Klenow 2018, figure 2).

3. Characteristics of Advertisements

3.1. Types of Ads

Economists classify advertising into two types, persuasive and informative. "The persuasive view of advertising typically sees changes in preferences in the form of an outward shift of demand, a decrease of elasticities of substitution between products, or increased monopoly power of firms, and thus increasing market prices, while the informative view sees increased information for consumers, thus stronger competition and lower market prices" (Rauch 2012, p. 332). The CMA recognizes this distinction and views informative advertising as generally improving consumer welfare. See, for example, this paragraph from the CMA (2020, app. O, para. 25) report: "Conventionally advertising can be thought of as having a number of different purposes—persuasive, informative and complementary—and the impact on consumer welfare will depend on the purpose. For example, where advertising improves the information available to consumers it will also improve consumers' knowledge and understanding of prices, product quality etc, helping to grow demand in a market and so improve consumer welfare."

There is a large literature in economics about whether advertising product prices tend to increase or decrease product prices in a market. See Rauch (2012, 2013) for a recent summary and econometric analysis. His analysis suggests that informative advertising increases consumer welfare, while persuasive advertising typically does not. This is consistent with most other theoretical models; see Bagwell (2007), Shapiro (1980), Rauch (2012), and many others.

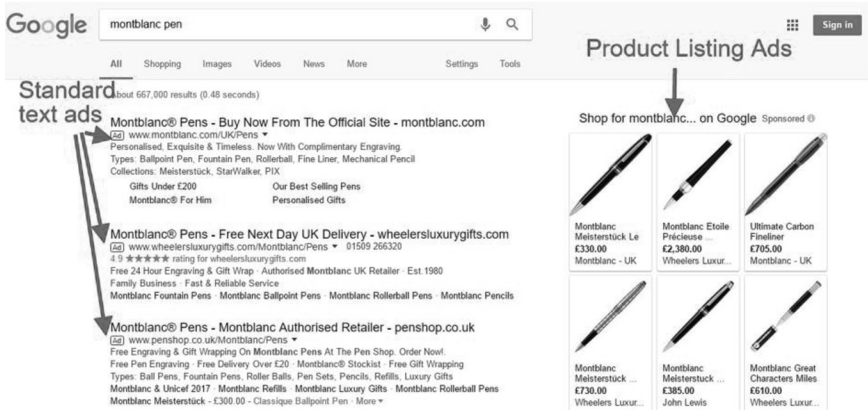

Figure 5. Text ads and product listing ads

3.2. Prices and Competition

There are often various regulations about what can and cannot be advertised in a given state. For example, in some states it is illegal to advertise the price of liquor or the price of legal services. When such restrictions are lifted, one commonly sees the price of the product decrease, which suggests that informative advertising—such as product prices—seems to make markets more competitive.

Here are a few of the many papers on this topic: Benham (1972) and Kwoka (1984) on eyeglasses, Feldman and Begun (1978) on optometry, Clark (2007) on cereal, Cady (1976) on drugs, Milyo and Waldfogel (1999) on liquor, and Schroeter, Smith, and Cox (1987) on legal services. Most of these papers examine print ads, but it seems plausible that the relationship between advertising costs and product prices also occurs with digital ads.

This effect is due in part to the evolution of ad formats. When people use Google search to look for products, they often see product listing ads (PLAs). Usually PLAs are presented in a row of product images, along with information about the products, merchants, and prices. When a user clicks on a PLA, more information about the product is provided. It seems quite clear that PLAs can be classified as informative advertising.

Search ads may or may not display product prices—that is up to the advertiser. However, PLAs are required to post prices.[4] Figure 5 is a screenshot showing ordinary ads and PLAs that show up in response to the query "montblanc pen."

On the basis of the literature cited above, one would expect that requiring PLAs to display prices would make the market more competitive and lead to lower prices for products. Perhaps this is one reason why prices for goods sold

[4] Bing product ads, Facebook product ads, and Amazon sponsored product ads also require product prices to be displayed.

online tend to have lower prices than similar goods sold offline, as illustrated by Goolsbee and Klenow (2018).

4. A Simple Model of Advertising

I now consider a simple model of ad costs and product prices. The goal is not to present a general model of advertising but rather to show that there are simple, plausible models that do not exhibit pass-through. In the model developed here I show that when ad costs increase, merchants will choose to advertise less, but they will not change the price of the product they are selling.

Consider a merchant who imports frying pans from Asia and pays a constant marginal cost for each pan. To determine a profit-maximizing price for the pan, the merchant recruits a random sample of potential users from a population of consumers and ascertains their willingness to pay using marketing techniques such as conjoint analysis, surveys, cost comparisons with similar products, experiments, and so on.

This sample of users—which I refer to as the audience—could be stratified in some way. For example, the audience could be a random sample of consumers who clicked on an ad for frying pans on a website about cooking. Or it could be a group of consumers who saw a demonstration of the product shown on late-night TV.

I let $km(a)$ be the marketing cost of acquiring an audience of size a; here k is a shift parameter that shifts marketing costs up or down. I take $km(a)$ to be an increasing, convex function of audience size. Assuming convexity makes sense because it is costly to acquire additional audience members with the desired characteristics as the audience grows. For example, if you want more people who clicked on an ad for the frying pan, you may have to pay more to acquire a prominent location on a web page or a more prominent time slot on the televised cooking program.

I adopt a standard discrete-good framework to model consumer behavior. Let v_i be the value (or willingness to pay) for the frying pan by consumer i. As usual, I assume that the consumer purchases the frying pan if the price is less than its value. If $F(v)$ is the cumulative distribution function for values, then the probability of purchase is $D(p) = 1 - F(p)$. Although $D(p)$ is known as the survivor function in statistics, here it is natural to refer to it as the normalized demand function. If there are a consumers in the audience, and a fraction $D(p)$ buys the frying pan, then the number of frying pans purchased is $D(p)a$, and the revenue from frying pan sales is $pD(p)a$.

The profit function can then be written as

$$pD(p)a - cD(p)a - km(a) = (p - c)D(p)a - km(a),$$

an expression reminiscent of the classic Dorfman-Steiner model (Dorfman and Steiner 1954):

$$PD(P,\ A) - C[D(P,\ A)] - kA.$$

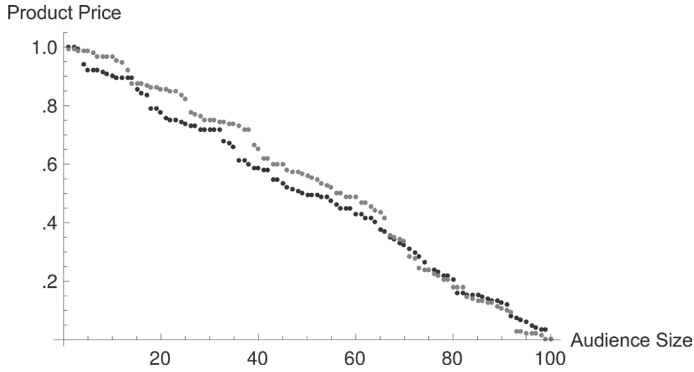

Figure 6. Demand functions with uniformly distributed willingness to pay

There are three differences from this model and the Dorfman-Steiner model, namely, the assumption of constant returns to scale in producing or procuring the good sold; the separability of the demand function, so $D(P, A) = D(p)a$; and the assumption that the cost of advertising is linear in the Dorfman-Steiner model but is convex in this model.

It is important to recognize that separability of the functional form is not just an arbitrary assumption but a direct consequence of the discrete-good framework. The discrete-good model implies that if you (randomly) choose an audience that is twice as large as a given audience, the optimal price will be roughly the same, and the optimal profit will be twice as large. This is why the merchant can use a small sample of users to determine prices and still have some confidence that the optimal price from the random sample will be more or less optimal for a larger (or smaller) audience as long as the sample is a representative sample from the population. For more on the discrete-good models, see Anderson, de Palma, and Thisse (1992), Armstrong and Vickers (2014), and McFadden (1980).

The formalization of this intuition is the Glivenko-Cantelli theorem, which says that the sample cumulative distribution function converges uniformly to the underlying probability distribution. The Glivenko-Cantelli theorem is informally known as the fundamental theorem of statistics since it shows why a random sample is informative about the population from which it has been drawn. See Pitman (1979) and van der Vaart and Wellner (1996) for details.

Figure 6 shows two normalized demand functions based on two samples drawn from a uniformly distributed willingness to pay. In this case, the theoretical normalized demand function is $1 - p$, but the actual demand functions display some randomness since they are samples from the population distribution. Nevertheless, the demand functions will generally be similar since they are samples drawn from the same distribution.

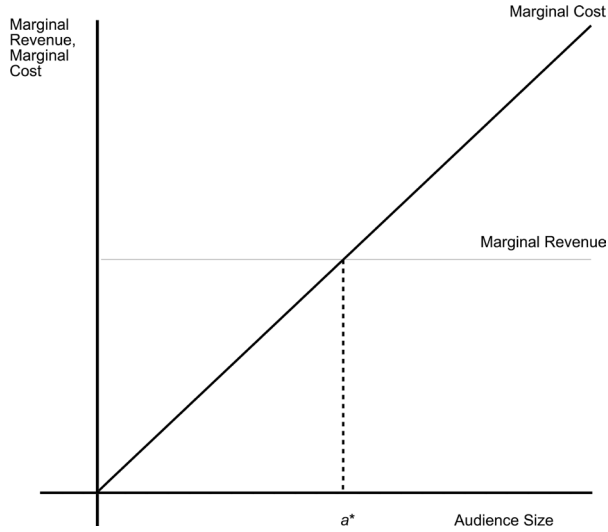

Figure 7. Optimal profit-maximization choices

4.1. Implications of Separability

The profit function described above has the convenient feature that it can be solved in two stages: first determine the profit-maximizing price, and then use that price to determine the optimal audience size. The first stage is pricing, and the second stage is marketing. Here is the simple argument.

Recall that the profit-maximization problem is $\max_{a,p}(p - c)D(p)a - km(a)$. The natural way to solve this problem is to first choose the price to maximize profit per consumer, $r(p^\star) = \max_p(p - c)D(p) = (p^\star - c)D(p^\star)$, and then choose the size of the audience to maximize overall profit, $\max_a r(p^\star - c)a - km(a)$. In this model an increase in k will increase the cost of advertising but has no effect on the product price, since it is already set at the profit-maximizing level. On the other hand, a change in the marginal cost of production or a shift in the demand function will generally affect the product price, as usual.

One case that is useful to explore with algebraic examples is when the willingness to pay is uniformly distributed, so $D(p) = 1 - p$ and the marketing cost function is ka^2. For this case, marginal revenue and marginal cost are both linear, and it is easy to solve for the optimal choices, as shown in Figure 7.

In this model the profit-maximizing product price does not depend on the size of the audience. To the contrary, the profit-maximizing price will be (roughly) the same for any sufficiently large audience. In this model, the advertiser cannot affect the willingness to pay, which indicates that this is a model of informational advertising, not behavioral advertising. Informative advertising is the predominant type of advertising online, so that is the case that is most relevant here.

Of course, the product price can respond to changes in marginal cost c and/or a change in the distribution of consumers' willingness to pay. These variables determine profit per audience member, while audience size determines overall profit.

The first-order condition for determining the choice of audience size can be written $r(p^*) = c + km'(a)$. This expression is simply marginal revenue equals marginal cost, but now there are two components to marginal cost, the cost of acquiring an additional frying pan c and the cost of acquiring an additional purchaser $km'(a)$. The product price is independent of the cost of marketing but not of the marginal production cost.

As shown, separability is very natural in this model. That being said, it is also a restriction. Without separability, the profit-maximizing price for the product could depend on audience size. For example, this could happen if the product exhibited supply-side or demand-side economies of scale.

Here is an example of a profit function in which separability fails:

$$\pi(p, a) = p(a - p) - kpa^2.$$

The profit-maximizing solution is $\{p = \frac{1}{8}k, a = \frac{1}{2}k\}$, which shows that the cost of advertising k affects product price in this particular case.

4.2. *Intuitive Argument*

Suppose the merchant has assembled the audience using a panel of consumers and has determined a profit-maximizing price on the basis of that panel. Now the marketer—the agency that finds audiences for the merchant—raises the cost of its services. Can the merchant pass along that cost increase to the consumer? No, because the merchant was already charging the profit-maximizing price. If it could have increased profits by raising that price after the cost increase, it should have already done so before the price increase.

It is well known that if a factor cost increases, a cost-minimizing firm will reduce its demand for the factor (see, for example, Varian 1992, p. 35). But there is no general presupposition about what happens to prices. In the simple model presented here, the product price does not depend on audience size, so an increase in the cost of acquiring an audience results in a smaller audience and fewer sales but has no impact on product price.

4.3. *Consumer Behavior*

It seems plausible that it costs less to assemble an audience now than it did before the Internet. In terms of the model, k has decreased, so audience size and the number of purchases has increased, which increases producer surplus. Consumer surplus would be expected to increase as well since the number of purchases has increased.

On the other hand, it may be that the ads are distracting to those who have no intention of purchasing. This distraction cost is sometimes known as the ad

load. One way to model the ad load is to think of consumers who are in market and those who are not in market. The in-market group may well value the information the ads provide, while the out-of-market group endures a cost from the increased ad load due to displaying ads that are not of interest.

A monopoly provider of marketing services may be socially beneficial since the monopoly will generally want to increase the cost of advertising. This will lead merchants to acquire a smaller audience, which reduces the number of sales, which reduces social welfare.

This is also a case for which PLAs are attractive, since they are often displayed in a carousel arrangement. The user sees only three or four ads but can choose to scroll to the left or right to see additional ads. This scrolling makes it easy for the user to choose how many ads he or she sees. Consumers who are in market may want to see the distribution of products and prices, while those who are not in market can choose to avoid seeing additional ads.

4.4. Other Models of Market Structure

Suppose there is a Cournot model with constant marginal cost. The normalized demand function can be used to solve for the equilibrium price as above. This gives the per capita profit, and from that the profit-maximizing level of marketing can be determined. The same procedure works for other textbook examples of market equilibria. The critical issue is whether the firm can shift the product demand curve. If so, that is in the realm of behavioral advertising and outside the scope of the informational advertising model described here.

However, exogenous shifts are a different story. If the cost of advertising increases so much that some producers are driven out of business, the demand curve facing the remaining producers shifts, and the equilibrium price will likely increase. There are two responses to this observation.

First, as shown above, advertising is generally a small expense; historically it has been about 1 percent of GDP. This suggests that an increase in the cost of advertising is unlikely to lead to a large exit. Second, a price increase due to exit is not really passing along a cost increase; it is about how demand changes as the number of firms changes. If there is significant exit, the remaining firms may well increase the price they charge, but that is the result of a shift in demand rather than of passing along a cost increase.

5. Summary

The cost of online advertising has decreased for many years and has trended upward only recently, mostly likely because of the COVID-19 pandemic. Over the years, it appears that product prices for goods sold online have declined or have remained more or less constant compared with GDP. In this article I argue that online advertising is primarily informative in nature, and I present a simple model of informative advertising in which product prices are independent of the cost of advertising.

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