Demand cross elasticity without substitutability: An experiment☆

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ABSTRACT

We study a market in which goods are produced under low marginal costs with a poor degree of substitutability among products. In this environment we ran an experiment to explain why prices are interdependent even when preferences are independent. We compare our results to previous theoretical and laboratory experimental literature on price fairness. We find that even in the absence of interaction among subjects, price fairness/unfairness does play a major role in the decision to accept or reject a deal. Subjects tend to be more resistant to a price increase and reject a deal when the preferred product is not referenced to price increases of not substitute products, if these products are considered to be a benchmark for fair conduct. Thus demand cross elasticity can arise between products that are not substitutes. This result has important implications for antitrust policy. In delineating a market perimeter, fairness concerns suggest that products that are similar but not interchangeable should be included in the relevant antitrust market.

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1. Introduction

There are products or services that consumers refer to in deciding whether or not to buy other, similar but not substitute ones. Consider soccer fans who have to decide whether to buy a season ticket. Naturally they would never consider switching to another team, yet they do actually take into consideration "similar" season ticket prices posted by other teams in the same league.[2] We therefore expect the prices of season tickets to have reciprocal effects on their respective demand despite the lack of genuine substitutability: in short, we can detect the presence of some degree of demand cross elasticity between non-substitutes.

This phenomenon cannot be plausibly explained in traditional economics textbooks, according to which cross elasticity depends strictly on substitutability. Rather, it would appear to be connected with buyers' considerations of fairness: fans will take season tickets for their team if they perceive that they are priced fairly with reference to other teams' prices. In this case, the supporter's utility function must include this fairness factor.

This paper is based on the hypothesis that consumers' utility depends not only on the "acquisition" utility of the relevant good but also on the terms of the transaction, as in Kalman (1968). This approach boils down to the choice of the point of reference, an essential ingredient of every theory involving fairness. The reference price determines the context to which consumers refer in choosing, in particular when considering the threshold for accepting or rejecting a given transaction.

The intuition is that in such circumstances, the logical candidate for this role is the price of similar, but not substitute, products. From the evidence, we can infer that consumers do pay attention to these prices in evaluating the product they intend to buy, and that firms behave accordingly. A natural continuation of this train of thought is that prices of similar goods that serve reciprocally as reference points, should influence each other. As a consequence we may observe prices of similar goods converging toward a unique price even if the products are highly differentiated and the consumers evaluate them as non-rival goods. So a certain degree of price uniformity can be expected even among highly differentiated

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[2] An inquiry by the Italian Competition Authority found that football clubs monitor the prices charged by clubs based in other cities, which would appear to be at odds with the lack of substitutability. The influence of foreign prices on internal competitive conditions (when internal and foreign markets are clearly separated) is another good example, also taken from the activities of the same Authority. An inquiry into the pricing of formula baby milk by the Italian Competition Authority showed that prices abroad were much lower than in Italy. Consumers do not usually go abroad to buy this type of product, but the finding triggered a powerful reaction among consumers, which made possible the entry of a new firm into the market, with a substantial impact on domestic prices (Sabbatini, 2008, pp. 497–499).

products. And this is precisely what we observe in several market contexts.

Consider, for example, the music CD market. Traditional analysis predicts that prices of CDs belonging to the same category should show high cross-section variability: with low marginal costs and high overhead costs, and the goods being poor substitutes, prices should mainly reflect the specific demand for musical artists and should consequently diverge substantially. Instead, we find a convergence of prices through some common values. The retail prices of recently launched CDs of two artists far apart in popularity (so that one might well expect different demand elasticities), are almost the same. This pattern is not confined to the music CD market. Ticket prices for football matches of clubs in the same league but different cities are very similar, independently of the number of their local viewers (and supporters). More generally we find the same price pattern for films, CDs, DVDs, standardized software, live concerts and sports events, all markets characterized by great product differentiation, high fixed costs and negligible marginal costs. Might considerations of fairness explain this evidence?

This paper is prompted by the intuition that the price of a good (say, the latest CD by Beyoncè) can be used as a referencing heuristic to base fairness consideration for the acquisition decision of a similar but not substitute product (say, Bruce Springsteen's latest CD). So these two products show a high degree of price similarity not because they are substitutes but because their prices are reciprocally used as a benchmark in assessing fairness in pricing.

The peculiar demand links among non-interchangeable products that we explore here may justify some considerations on firms' strategies and pricing. In particular, we expect that firms, aware of these connections, may consider cooperation to relax reciprocal constraints due to the referencing role of their prices. Furthermore, effective market power needs to be assessed correctly, taking into account the influence of producers of similar products. Hence our analysis asks for a reconsideration of the notion of the antitrust relevant market, commonly restricted to interchangeable products only. This paper suggests, instead, broadening the notion to include some non-substitute goods where they are referred to by consumers as standards of fairness. That is, an antitrust market cannot rest only on the notion of substitutability but it should also include products that serve as a referencing heuristic for consumer choices.

The paper is organized as follows. In Section 2 we review the literature on reference-price and price uniformity in highly differentiated product markets. Section 3 presents a model in which consumer's choice depends not only on utility but also on perceived fairness. In Section 4 we focus on the peculiarity of the CD music market, which despite great product differentiation displays shows a remarkable degree of price uniformity. In Section 5 we describe an experiment aimed to bring out the causal relationship between transaction price fairness and price uniformity. Section 6 reports the results of the experiment, and the concluding section discusses the paper's findings, including the main implication for competition policy.

2. The literature on reference-price and price uniformity

Fairness in transactions is a popular theme in the economic and marketing literature. A number of papers show that fairness does play a role in characterizing economic behavior. Some references can clarify its nature. Three questionnaires (Thaler, 1985) reveal that the perception of cost influences the assessment of fairness, which in turn conditions consumer choices. Household surveys (Kahneman et al., 1986a,b; Frey and Pommerehne, 1993) confirm the relevance of fair conduct: in particular, price increases due to cost shocks are considered fairer than price increases due to demand shocks.

These empirical findings throw doubt on the robustness of consumer theory in which preferences are strictly self-centered. In fact, other-regarding preferences can also play a significant role, and attitudes toward fairness can be a factor. Various analytical models have been offered to explain these empirical observations. Kahneman et al. (1986a) pioneered with the "dual entitlement" approach, which hinges on the idea that transactors (consumers, workers) "have an entitlement to the terms of the reference transaction, and firms are entitled to their reference profits". Only when profits are jeopardized are firms entitled to modify prices (or wages) to transactors' detriment. It is interesting to notice how the fairness of a transaction is defined:

> "*The measure of transaction utility depends on the price the individual pays compared to some reference price, p*. (. . .) The most important factor in determining p* is fairness.*" (Thaler, 1985, p. 34).

This line of research has attracted a good deal of interest and has raised a number of issues related to the precise meaning of the sense of fairness,[3] the factors that influence it and its impact on consumption choices and pricing decisions. Some articles review the main analytical contributions and show the amount of empirical and experimental research on the topic: some focusing on price fairness (Xia et al., 2004) and some on other-regarding preferences (Cooper and Kagel, 2009).

The focus of this approach is on how consumers conduct the comparison that triggers the sense of price-unfairness. Three referencing heuristics have been proposed: (a) previous prices, (b) seller's costs, and (c) prices of competing goods.

Previous prices – One obvious way to trace back a reference price is to look at the earlier prices charged for the same product. Experimental studies (Briesch et al., 1997) as well as analytical contributions (Kahneman et al., 1986a; Rotemberg, 2004), seem to confirm this point of view. In particular, Rotemberg (2004, p. 4) refers to consumers' angry reactions triggered by learning "*something that makes them wish they had carried out a different set of transactions at an earlier time*". So the reference to previous prices is the starting point of his analysis. The fact that price changes are not easily interpreted by consumers does not affect this approach, which is designed to explore the rationale for sticky pricing. Consumers are assumed to be generally hostile to price increases, as they do not understand the underlying rationale.

Putler (1992) presents an analytical model of consumer choice based on utility functions that also encompass, as arguments, marginal losses and gains. These losses and gains are determined by the difference between the price of the product under consideration and its reference price, which is an expected price based on past values. The author gives econometric evidence of this effect, which basically shows that demand price elasticity is high when prices increase and low when they decrease.

Seller's costs – Other approaches, while introducing the role of fairness in economic behavior, assume that consumers make some inference on the cause of price changes. That is the case for the "dual entitlement theory" (Kahneman et al., 1986a), by which only price changes that are not justified by cost increases can trigger consumer reaction. Thaler clarifies this point by arguing that the reference-price is based on costs (Thaler, 1985, p. 34). Similarly Okun (1981) – who is generally credited for having originated the literature on fairness – notes that only price increases that are unjustified by cost increases can provoke considerations of unfairness, which implies that consumers use costs as a reference point in evaluating prices. Interestingly, these approaches offer an explanation for

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[3] Smith (2005) reports a long list of different notions of fairness employed in this branch of economic literature.

price mark-up, a pricing policy that anticipates unfairness reactions by consumers.

According to this theory, consumers know the sellers' cost structure, an assumption that certainly cannot be taken for granted. For example, Bolton et al. (2003) present experiments in which consumers are unable to distinguish the reasons for price increases and are puzzled by inflation. Consumers lack access to cost information and cannot extrapolate correct conclusions[4] from the limited data they do have (Bolton et al., 2003). This would appear to be decisive in itself. But we can add a further argument: in our market overhead costs prevail over marginal costs, and price structure should be settled by firms according to the strength of the several components of demand. In this case there is no satisfactory way for consumers to relate unfairness concerns to the cost structure. Costs, then, seem to be an unsuitable price-reference.[5]

Prices of substitute goods - A number of works have explored the impact on marketing strategies of perceptions of prices of substitutes[6] in connection with fairness (Xia et al., 2004; Anderson and Simester, 2008; Dholakia et al., 2005). When products look alike, it is argued, price comparison is easy and consumers can easily detect unfairness. This thesis cannot be endorsed: we rather think the opposite. The prices of substitutes cannot be considered a benchmark for unfairness, which instead is inevitably associated with the lack of alternatives[7]: if the substitute goods are cheaper than the one being considered, consumers simply choose the lower-priced alternative, possibly after a learning process. So it is only when the degree of substitutability is low (or when market power is great) that unfair behavior (and fairness considerations) arises. Fairness should not play any role when firms do not have market power, because in this case consumers have alternatives and firms cannot exploit unfair behavior. It follows that if our benchmark is prices of competing products, the relevance of the sense of fairness is restricted merely to short-term disequilibria.

In short, then, all these approaches to reference price prove to be unsatisfactory. On the one hand, buyers are generally unable to analyze either the previous prices or the cost structures of sellers. And on the other, we do not expect there to be competing products when fairness is an issue.

Notice that the literature, although originally focused on prices, took various directions, and the reference notion gradually switched from prices to product characteristics. The present literature on loss aversion typically considers consumer utility functions conditioned by "frames" or "reference structures" that refer to some standard, or expected, or pre-existing characteristic bundles.[8] Our contribution is a step back from this approach. That is, we restore

the focus to price comparison (with a reference product) for the purpose of judging the fairness of the proposed trade.

The only article, to our knowledge, that deals explicitly with the referencing role of non-substitute products is Anderson and Simester (2008), which examines the prices of clothes of different sizes. Their evidence suggests that the demand for clothes is influenced by the prices of clothes of different sizes, inducing a high degree of price uniformity. The authors find that this pattern is due to the sense of unfairness; the indirect effect of the perception of unfair pricing is much stronger in reducing consumer demand than the direct effect of the price increase itself. The article can thus be read as a contribution to the analysis of price uniformity in markets for highly differentiated products, a phenomenon that has been detected in a number of empirical studies.

McMillan (2007) offers partly anecdotic evidence of the degree of homogeneity in retailers' pricing of tea, wine, clothing and books. Other papers study the gain in profits from abandoning price uniformity (or limited price differentiation) in the music CD market (Shiller and Waldfogel, 2011) and in movie theaters (Leslie, 2004; Orbach and Einav, 2007). Additional evidence comes from the sticky price literature, which emphasizes low inter-temporal price discrimination (Ball and Mankiw, 1994).

Three explanations, all hinging on the supply side, have been suggested to address the problem of uniformity, purportedly non-optimal, in pricing: (1) menu costs; (2) softening competition; (3) vertical contracts. Some authors (Leslie, 2004; Ball and Mankiw, 1994; McMillan, 2007) and a number of businessmen (interviewed by McMillan, 2007) maintain that menu costs, variously defined, can explain firms' pricing practices. That is, the additional earnings that can be attained by greater price differentiation, do not always cover the cost of the precise calculation (and updating) of prices tailored to distinct demand segments. A second argument sees price uniformity as the outcome of strategic behavior by firms, aimed at softening competition across different markets (Corts, 1998). Finally, Orbach and Einav (2007), to explain what they consider as unprofitable pricing behavior by movie theater managers, trace the cause to the legal regime that forbids vertical arrangements between distributors and the theaters.

The authors themselves acknowledge that these supply-side approaches do not offer a convincing explanation of the low degree of price differentiation they find. We accordingly turn to a different line of research, hinging on the demand side and in particular on considerations of price fairness or unfairness that appear to motivate consumer behavior.

3. Transaction utility as an explanation for demand cross elasticity

Our basic intuition can be set out as follows. Traders naturally look for a reference-price, which is a synthetic indicator of general market conditions, conveying information relevant for the exchange. In traditional markets, where the goods are standard or undifferentiated, this function is performed by the competing products themselves. For this reason the function cannot be isolated, as it is associated with relationships of substitutability. But markets with highly differentiated goods can be considered genuinely monopolistic, as no product competes with any of the others. Nevertheless, consumers still need some reference-price to assess the fairness of the deal they are offered, so they take what is avail-

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[4] The retail price of gasoline is related to the price in the wholesale oil market, but the number of retail markets that work like the gasoline market appears to be quite low indeed.

[5] In an empirical survey conducted in Switzerland (Frey and Gygi, 1988; Frey and Pommerehne, 1993) an increase in the price of snow-chains on snowy days was perceived by the general population as highly unfair. This is also the major contribution by Franciosi et al. (1995); albeit from a different perspective, they describe several experiments showing that buyers get used to a price increase (that is, the eventual initial feeling of regret vanishes) after a while, whether or not it is justified by higher costs.

[6] Briesch et al. (1997), Alba et al. (1994), Lichtenstein and Bearden (1989), and Dholakia et al. (2005).

[7] In the Rotemberg model the sense of unfairness coexists with alternatives because it arises out of a comparison between a present and a hypothetical purchase, which could have occurred at an earlier time. But in this case the comparison is with previous prices.

[8] In these cases price fixing or price raising by firms is fully accepted (perceived as fair) by consumers. Otherwise anomalies (Kahneman et al., 1991) emerge. With relation to the three classical anomalies: (1) endowment effect, (2) loss aversion, and (3) status-quo bias, the endowment effect – a typical seller-side anomaly (Beggs and Graddy, 2009) must be excluded from our analysis, which considers only consumer-buyer behavior. Under these general conditions of price-making firms and price-taking consumers, all transactions turn into exchanges. While the bulk

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of the literature on price fairness is focused on the seller side, our paper is mainly focused on price-unfairness issues on the consumer side. Brown (2005) presents a real cash experiment in which loss aversion does not depend on the endowment effect and offers a different explanation for the WTA-WTP disparity with relation to inexpensive market goods with ample substitutes.

able: similar products. The products are similar not only in product classification but also in being subjected to the same economic forces (they all are "quasi" monopolies). The rationale for comparing quasi-monopolies can be traced back to a notion of fair price that monopolists too must adhere to. The peculiar cost structure of these markets must also be considered. Overhead costs are often paramount, so marginal costs offer no clear reference for fairness in pricing, which is one more motivation for the recourse to the prices of similar products.

3.1. The model

The cross-elasticity of demand is usually associated with the substitutability of products. The demand for product "1" increases as the price of product "2" rises, because some consumers shift to product "1": that is, they consider the two products to some extent interchangeable, so variations in relative prices modify the demand for the two goods. This relationship can be exemplified by employing the Bowley model of differentiated products (Bowley, 1924)[9]: in the case of two substitute products (x_1, x_2) the utility function for the representative consumer and the budget constraint are respectively:

$$U(x_1, x_2, m) = a(x_1 + x_2) - \frac{1}{2} b(x_1^2 + \theta x_1 x_2 + x_2^2) + m \quad (1a)$$

$$M = x_1 p_1 + x_2 p_2 + m p_m \quad (1b)$$

where θ is the parameter that measures the degree of substitutability between the two goods, m is all the other goods (price normalized at $p_m = 1$), a and b are the parameters that measure the weight of products x_1 and x_2 respect to the composite good x_m, and p_i is the price of good i, for $i = 1,2$.

From (1a) and (1b) we derive the two demand functions:

$$x_1 = c_0 - c_1 p_1 + c_2 p_2 \quad (2)$$

$$x_2 = c_0 + c_2 p_1 - c_1 p_2 \quad (3)$$

where

$$c_0 = \frac{a(1-\theta)}{b(1-\theta^2)}$$
$$c_1 = \frac{1}{b(1-\theta^2)}$$
$$c_2 = \frac{\theta}{b(1-\theta^2)}$$

Our intuition is that we can observe demand cross-elasticity even between two products that are not substitutes for one another. In other words, the thesis is that there does exist demand cross-elasticity not associated with a direct shift in consumption between two products and that this relationship depends on consumers' perception of price fairness or unfairness.

This insight could be framed in the language of transaction utility theory (Kahneman and Tversky, 1979; Thaler, 1985; Kahneman et al., 1986a), which posits that the total utility accruing from a transaction is given by the sum of two components: acquisition utility and transaction utility.

Acquisition utility is the factor considered by the traditional theory, and is equal to the value derived from consuming the good less the price paid for it. Transaction utility is related to considerations of fairness and depends on the comparison between the actual price charged by the seller and some reference price. It follows that transaction utility can also be negative, in the case of perceived unfairness.

To adapt this conceptualization to the equations above, let us now consider a product whose price (p_y) is the representative consumer's reference price for fairness[10]:

$$U(x_1, x_2, m, p_y) = a(x_1 + x_2) - \frac{1}{2} b(x_1^2 + 2\theta x_1 x_2 + x_2^2)$$
$$+ m + \gamma(x_1 + x_2) p_y \quad (4)$$

Subject to the above budget constraint (1b). Where γ is the parameter that measures the referencing strength of the reference-price (p_y).

The second part of Eq. (4) deals with consumers' perception of fairness: the utility of consuming x_1 or x_2 changes in proportion (γ) to the reference price (p_y). In practice, we assume that the utility to the representative consumer also depends on the hypothetical value of the two products priced at the reference price. Notice that the product whose price is chosen as reference does not enter the consumer's preference set.[11] Therefore products are only allowed to have mutually exclusive substitution or fairness effects. From this utility function we can derive the following system of linear demands:

$$x_1 = c_0 - c_1 p_1 + c_2 p_2 + c_3 p_y \quad (5)$$

$$x_2 = c_0 + c_2 p_1 - c_1 p_2 + c_3 p_y \quad (6)$$

where c_1 and c_2 as before and $c_3 = (\gamma(1-\theta))/b(1-\theta^2)$.

This demand system looks familiar. But the interpretation of the coefficient (c_3) for the reference price (p_y) is different from the standard one (c_2). Generally, the price coefficient of one product in another product's demand equation implies some degree of substitution. In our case, the coefficient (c_3) depends on the parameter γ, which accounts for the price fairness perception.[12] It also depends on the degree of "closeness" (θ) between the goods x_1 and x_2: because $\partial c_3 / \partial \theta < 0$, the more closely the products are substitutes, the smaller is the role played by considerations of fairness.

Therefore demand cross-elasticity could arise not only from the acquisition utility component of the utility function, in line with traditional theory, but also from the presence of a second component (transaction utility) due to a referencing system. If this is so, then in the peculiar market context we consider we should observe demand cross-elasticity without a shift from one product to another. We also expect that price changes for some products do exert some influence on the demand for other products even when they are not substitutes. It follows that these goods and services must show some degree of price uniformity: firms, if they are aware of their potential buyers' sense of price fairness, will carefully evaluate the adverse impact of price differentiation. Therefore the Jevonsian single-price rule may also apply to markets with highly differentiated products.

4. The subject of the experiment: the music CD market

We ran an experiment on the music CD market, which is a good candidate to test our model and our interpretation of demand-driven price uniformity. This market is highly differentiated, in that consumers exhibit strong preferences for some musicians and

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[9] See also Martin (2002, pp. 52–54) and Motta (2004, pp. 561–563).

[10] The value of y, with respect to m, is negligible, so we can still normalize the price of p_{m-1} to the value of 1.

[11] In the language of choice theory we can say that the consumer's "consideration" set does not coincide with the "preference" set: this framework for decision connects the consideration set with the perception of price fairness. In such a context the axiom of Independence of Irrelevant Alternatives does not always apply.

[12] One of the two dimensions of the consumer's evaluation of fairness in Daskalopoulou (2008) is price farness; the second is service fairness. The author allows for different combinations of price and service fairness.

relative indifference to others.[13] At the same time, at every point of sale (physical or virtual) retailers display a remarkable degree of price uniformity (Shiller and Waldfogel, 2011), once maturity is taken into account.[14]

This fact is particularly clear in the case of downloaded digital music: for example, all songs supplied by Apple iTunes are sold at the same price. But it also goes for CD retailers, in particular large distribution chains (in Italy, for example, COOP or Auchan). As a consequence, consumers perceive the music market with an inner characteristic of price uniformity. According to a recent investigation by the European Commission:

> "Some 60% of all the customers who responded to the market investigation claim that majors price their products similarly. Notably, some claim that prices are similar within price ranges (full price, mid, budget), and are rather similar for chart albums but less for catalogue." (European Commission, 2007, p. 104)

The prices of the CDs observed for our experiment (the top 20 of the week before) confirmed this uniformity: most (12) have the same price (€20.90), another 5 went for just €1 more, and the remaining 3 were more sharply differentiated.[15]

This price uniformity is the outcome of a complex process that begins with music labels (majors and independents) choosing a specific published price to dealers (PPD) for each record and fixing the appropriate discount for each type of retailer. PPDs are wholesale list prices applied to CDs according to various criteria (basically, type of product and commercial maturity). Firms use only a limited number of PPDs: the first 5 PPDs generally account for a large majority of total sales. Every record goes for a series of different PPDs in the course of its commercial life, starting from the highest. The PPDs of different labels show minor differences and are used in the same pattern by all of them. Discounts to retailers depend on the type of retailer, volume, promotions, etc. Although retail prices differ according to type of retailer, those of CDs of the same vintage at the same shop are similar. In part this reflects a definite practice on the part of retailers of equalizing the final prices of CDs, which means earning different margins. Therefore the price uniformity of CDs of the same vintage sold by the same retailer is basically due to a common mechanism for setting wholesale prices (based on PPDs) and to retailers' tendency to adjust their mark-ups for greater price equality.

How can we explain this propensity for price uniformity on the part of music firms and even more retailers? First, we must consider that firms are not always able to calculate the precise demand elasticity of any given CD and so resort to some general pricing rules. This is basically the function of the PPD system. Instead of initially pricing a CD according to expected demand, the label may prefers to launch it at a more or less standard PPD that will be kept unchanged as long as the CD receives attention from the public. When demand decreases, the company responds by lowering its PPD. This mechanism is appealing for niche CDs, but not so much for the pricing of hit records. Here, a better strategy would seem to be specific calculation of the demand for that particular record and the setting of an appropriate price based on that calculation.

Second, at the retail level it might be thought impractical for sellers to have to deal with multiple prices. One explanation might be menu costs, although these appear to be suitable principally for explaining the price stickiness of CDs.[16] In particular, we expect

that on-line sellers of MP3 files should not incur any significant menu costs in the case of a sharply differentiated pricing. Actually, however, it is precisely in this sector that we find the greatest uniformity of music prices. Thus the uniformity of initial retail prices must have other explanations.

We are inclined to think that this phenomenon is associated with the reference function of prices. Our thesis, that is, is that the prices of CDs in any given category are taken by consumers as a sort of referencing heuristic for the price of any CD in that category. This would force firms to apply the same price in order not to alienate customers.

5. Experiment design

Our experiment allows us to detect the presence of reference pricing only in a context of quasi-monopolies. That is, we employ a simplified version of the model indicated in Eqs. (5) and (6), as it deals with only one product (which the consumer can either buy or not) and one reference price:

$$x_1 = c_0 - c_1 p_1 + c_3 p_y \tag{7}$$

where $c_3 = \gamma / b$. According to the following modified version of Bowley equation:

$$U(x_1, m, p_y) = ax_1 - \frac{1}{2} bx_1^2 + m + \gamma x_1 p_y \tag{8}$$

The experiment tests the following prediction:

Prediction. *The experimental subjects exhibit reference behavior: the reference price of a good that is not part of their preference set influences the decision whether to accept or reject the deal proposed.*

5.1. The setting

The subjects of the experiment are undergraduate students at the University of Siena shopping for a music CD. Only students who had bought at least one CD in the previous twelve months[17] were eligible. The experiment involves consumption behavior concerning a list of 20 CDs. All are recent hits and all are sold at the same price (€18 is the average price of internet sellers).[18]

The experiment[19] is designed as follows:

Preliminary stage – We ask participants to choose between €3 in cash and a discount bonus of €9 for one CD from a closed list of 20 hits. Only those who opt for the bonus continue. Thus we screen out subjects with a very low reservation price (less than €9) for CDs. At this point the subjects are asked to fill out a questionnaire to elicit their own "open" list. The open list is designed to reveal the subject's personal "open" preferences, as against the "closed" list of hits. They can list up to twenty of their own favorite musicians, and in this way the experimenters can capture heterogeneous tastes of the subjects.

First stage – We ask students to reveal their first and second preferences[20] of CDs, from the closed list of 20 hits, at different discounts. We start by asking all participants which CD they would like to buy with an initial discount of €9. Then we ask if they want to buy other CDs at the same discounted price. We progressively increase the discount (up to €11) and check their reactions. The aim

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of this stage is to solicit each participant to reveal her/his reservation price for the specific list of CDs. This stimulates each subject to reveal her first choice, second choices and, finally, what we call here the "irrelevant alternatives", i.e. CDs she does not want to buy even when their price is very low.

Second stage – We start this stage by modifying the original list of 20 hit CDs. For each participant the new, shorter list consists of the first choice and all the "irrelevant alternatives". That is, we eliminate all second choices. We then divide the participants into two groups. We offer one group (*Sample 1*) the possibility of buying one CD from the modified list at the following prices: €13 (a €5 discount) for the first choice and €9 (the original €9 discount) for the irrelevant alternatives. We offer the second group (*Sample 2*) the possibility of buying one CD from the modified list for the same price of €13 (regardless of whether it is the first choice or one of the irrelevant alternatives). Students who decide not to buy any CD are compensated with additional €2. The function of this stage is to check whether the price of the rejected ("irrelevant") alternatives influences the decision to buy the favorite CD.[21]

All the participants, whether they choose cash or a CD in the final stage, receive €4 for their participation.

Due to their low income and the possibility of piracy, students do not buy many CDs and generally have a very low reservation price for recorded music. We handled this problem, first, by excluding those who preferred a small sum (€3) to a substantial discount of €9 on one of the CDs from our list. We also offered a very small amount of money as an alternative to the discount on music proposed in the last stage of the experiment.

5.2. Characteristics of the subjects

The preliminary and first phases serve to get each subject to reveal her/his first choice and all successive choices by providing the experimenters with information about a series of variables:

(a) number of CDs bought in the previous year (preliminary phase);
(b) preferences for "open" list (preliminary phase);
(c) number of second choices elicited under the "closed" list of top hits (first stage);
(d) number of CDs selected under high discount conditions.

Thanks to the preliminary and first phases, we learn the participants' preferences, which are then used to set up the last stage. We are also able to adjust our sample for heterogeneity by capturing whether the subjects differ both in "variety preference" (variables: (a)–(c)) and in "price sensitivity" (variable: (d)).

Because the experiment is based on the reactions of two groups facing different price structures, it is important that the two groups are homogeneous. As the aim is to test how and whether referencing to the prices of "irrelevant|" products conditions the behavior of subjects faced with a price increase for their preferred product, the risk is that the results may be distorted by other factors. We deal with this by paying attention to subjects' heterogeneity with relation to: (1) the range of preferences ("variety" effect) and (2) their sensitivity to decreasing price ("price-sensitivity" effect). "Price-sensitivity" is an obvious factor that could influence our results, so in partitioning the participants into two groups in the last stage of the experiment, we maintain the original proportions of price-sensitive and price-insensitive subjects. Similarly, we pay attention to the difference in attitudes to variety. Although we do not have a strong a priori on the impact of this factor, we suspect that it could influence participants' decisions in the last stage. In presenting and discussing the ultimate results, we shall show not only that this suspicion is well founded but also that this factor appears to interact with the sense of unfairness whose detection is the prime aim of the experiment.

In order to construct appropriate indicators of these two effects, we proceed as follows. First, in order to capture one source of heterogeneity, the "variety preference effect", the subjects are asked, before facing the "closed" list of the top 20 hits, to fill in a questionnaire with their own "open" list. This elicits the revelation of personal preferences, as the subjects can list up to twenty of their own favorite musicians. The experimenters – by comparing the choices from the open list (variables a and b) with the choices made by the same subject from the closed list (variable c) – are able to classify subjects in terms of their preferences. We have identified two types of consumer: (1) variety-preference consumers who in both open and closed lists select many musicians and (2) focused consumers, who in both lists select only a few musicians.[22]

The "price sensitivity effect" is detected by studying subjects' behavior when asked to reveal their first and second choices at different levels of discount. The aim of this increasing discount is to elicit "price sensitivity". With a succession of increases in the discount (initially from €9 to €10 and then from €10 to €11) the subjects experimentally reveal their switch to cheaper CDs. Measuring the preference for price decrease, we gauge the "price sensitivity effect."[23]

By this procedure we classify our participants according to the potential two sources of the heterogeneity we have identified, namely the variety and price-sensitivity effects (Table 1).

The choices of 21 subjects show desire for variety and 10 subjects present a clear sensitivity to decreasing prices. The proportion between "price-sensitive" and "price-insensitive" and that between pro-variety and focused subjects are similar for the two groups that take part in the two different treatments.

6. The results

6.1. The main result

In the second stage each subject faces only his/her one favorite CD and all the irrelevant ones. The subjects are partitioned in two groups – similar, as noted, in all respects except that one group (Sample 1) faces a price increase for all CDs including the favorite (*all CDs €13*), while the other (Sample 2) faces a price increase for

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[21] Price unfairness can also be perceived as lack of impartiality, because subjects – by revealing their preferences in the closed list in the first stage of the experiment – may consider this as a sort of option to buy a CD at a better price in the second stage. A discussant of this paper labeled this consumer's perception as a sense of deception, not unfairness proper. We do not agree, because no explicit promise was made in the first stage. In any case, the point is completely inconsequential with respect to the main result of the experiment which involves different behaviors explained by the prices of irrelevant products. It may also be that subjects reacted to their sense of lack of impartiality rather than a less severe perception of price unfairness; the fact remains that they did so to differing degree, and that this is explained by the prices of the irrelevant products. In this way no feeling of exploitation (and not even a sense of betrayal of trust) can arise. For a similar experimental interpretation of the differential preference for fairness among subjects, see Karni et al. (2008).

[22] In the first stage each subject is asked which CD (s)he might buy with an initial discount of € 9 off the Internet price. Then the subjects are asked if they want possibly to buy other CDs at the same price, measuring in this way their "love-of-variety". In this experiment we define a "love-of-variety" subject as one who selects 3 or more CDs at same price ($n_o \geq 3$) and a "focused" consumer as a subject who selects only 1 or at most 2 ($n_o \leq 2$).This classification is consistent with the ranking obtained by checking the number of CDs indicated in the open list at the preliminary stage.

[23] In this experiment we define a price-sensitive subject as one who selects a larger number of CDs at the new discounted price (n_v) than at the initial price (no), such that ($n_v >$ no); while we define a price-insensitive subject as one who at the new discounted prices selects fewer CDs than at the initial price or none (no).

Table 1
Classification of subjects according to source of heterogeneity: variety preference and price sensitivity (42 subjects who participated after the preliminary phase).

	Sample 1 (equal prices)			Sample 2 (different prices)		
	Variety preference	Variety adverse	Total	Variety preference	Variety adverse	Total
Price sensitive	2	2	4	4	2	6
Price insensitive	7	9	16	8	8	16
Total	9	11	20	12	10	22

Table 2
Acceptance and rejection by participants in stage two.

Session	Subjects in each session	Prefer €3 cash and stop	Prefer €9 bonus and continue	All CDs €13		First choice CD €13, others € 9	
				Accept (Y)	Reject (N)	Accept (Y)	Reject (N)
1	7	1	6	2	1	0	3
2	12	1	11	4	1	2	4
3	12	3	9	4	0	2	3
4	12	5	7	2	1	1	3
5	6	1	5	2	1	0	2
6	8	4	4	0	2	1	1
Total	57	15	42	14	6	6	16

Table 3
Buyers, non-buyers and the derived arc elasticities (distributed according to sample characteristics).

	Sample 1 (equal prices)				Sample 2 (different prices)			
	Variety preference	Variety adverse	Total	Elasticity	Variety preference	Variety adverse	Total	Elasticity
Price sensitive	(0; 2)	(0; 2)	(0; 4)	−5.5	(0; 4)	(0; 4)	(0; 6)	−5.50
Price insensitive	(5; 2)	(9; 0)	(14;2)	−0.37	(0; 8)	(6; 2)	(6;10)	−2.50
Total	(5; 4)	(9; 2)	(14;6)	−0.97	(0; 12)	(6; 6)	(6;16)	−3.14
Elasticity	−1.57	−0.55	−0.97		−5.50	−1.38	−3.14	

The first number within each set of brackets is the number of CD buyers and the second is the number who prefer cash.

the favorite but not for the irrelevant alternatives (*first choice €13, others €9*). In this way we control for the effect of the price-rise for the unselected (irrelevant) alternative CDs on the demand for the first choice. According to the conventional theory, we should not expect any difference between the two groups in the reaction to the higher price of the favorite CD. Subjects should only be concerned with the price of their own choice and should ignore the price of the CDs they are not interested in. But our experiment offers unambiguous evidence that disconfirms this view. The result of this stage can be summarized by comparing the numbers of buyers of the first choice (*Y*) with the number of non-buyers (*N*) in the two groups (Table 2):

(1) Group with equal price (€13) for first choice and irrelevant alternatives: $Y = 14$, $N = 6$; that is, their "rejection rate" is 6/20.
(2) Group facing different prices for first choice (€13) and irrelevant alternatives (€9): $Y = 6$, $N = 16$; that is, a rejection rate of 16/22.

The choices clearly show the *relevance of the irrelevant alternatives*. The data unambiguously indicate that when the price of the alternatives rises by the same amount as that of the favorite CD, consumers are less reluctant to buy. The result is stronger still considering its consistency in 5 of the 6 sections of the experiment. As expected, no one buys a CD considered uninteresting, even at a better price.

In short, participants shown a clear propensity to use the price of supposedly "irrelevant" products as a benchmark to gauge the price of the product they are interested in. When this reference price rises by the same amount as the first-choice CD, this is seen as part of a general price trend, which weakens the natural reaction of refusing to buy.

We are now in a position to measure this "fairness effect" experimentally as the difference in the behavior of our two samples. Without the fairness effect (when the price of irrelevant alternatives also rises), demand shrinks by 30%,[24] giving a price-elasticity of demand of −0.97 (Table 3). With the fairness effect (when only the price of first choice is raised) demand decreases by a further 42%,[25] implying an elasticity of −3.14. Our result is similar to that of Anderson and Simester (2008), who also find that the unfairness effect[26] is more relevant than the standard effect of a price increase.

The experimental sessions confirm our main point:

Result 1. *People tend to resist a price increase insofar as they use as a reference the unchanged price for similar but non-substitute goods. This is exactly in line with our prediction that the subjects will exhibit reference-price behavior: the price of a product that is not part of the preference set nevertheless influences the decision to reject the purchase.*

6.2. A secondary result

We obtain additional information on our subjects' behavior by controlling for the sources of heterogeneity: variety preference and price sensitivity. This analysis confirms our a priori expectations on the relevance of price-sensitivity, but it also reveals some unexpected outcomes associated with variety preference.

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[24] Percentage of rejections in the "same price" group.
[25] Percentage of rejections in the other group less the former percentage.
[26] In Daskalopoulou (2008) the measure of overall fairness is different from price fairness and service fairness because of the different degrees of fairness ascribed to each specific seller; in our work, the price of all the other non-substitutes enters the subject's sense of price unfairness in the same way.

Price sensitivity clearly plays a major role. No matter which group they belong to, price-sensitive subjects elect not to buy their favorite CD when the price is raised (Table 3). This is exactly what we expected.

As to variety preference too, we find a clear relationship between the decision to buy and focused preferences. Rejection is less common when consumers' preferences are more focused (a lower variety preference), more common when the variety preference is more pronounced. This relationship seems stronger in the case of the group where the prices of the first-choice and irrelevant CDs are different. In this group only the focused subjects opt to buy. That is, the reaction to price unfairness that is triggered in this group is magnified by the presence of variety preference. Notice that when all the prices increase some subjects with variety preference do decide to buy their favorite CD. In short, the attitude to variety is intertwined with the feeling of price unfairness, a result consistent with our model.

Result 2. *Rejection of the proposed purchase is more common among the consumers with variety preference.*

We posit two explanations for this finding:

(a) First, notice that in the second stage of the experiment the subjects with variety preference suffer a double shock. The first, common to all, is the price increase. The second, specific to this category, is the removal of varieties of CDs. It may be that the two shocks are mutually reinforcing, thus amplifying the impact on buying decisions.
(b) Second, we drew the information on price sensitivity from the lower portion of the demand curve (below the initial price of €9). It could be that subjects with variety preference have greater elasticity on the upper part of their demand function. In this case, we should expect that in the event of a price increase for their first-choice CD they may look for an alternative, which in our experiment means that they decide not to buy at all and elect to keep the money.

7. Conclusion

We can now support the two main conclusions, which confirm the intuition behind the paper:

(1) Considerations of unfairness are fundamental in consumer choice.
(2) The reference price is a heuristic for the subjects, and in the case of highly differentiated goods it is related to the price of non-substitutes.

The perception of unfair pricing is the driving force in the emergence of spiteful behavior when the price increase concerns the subject's chosen CD, even if price comparisons involve only CDs not selected in the first stage. This result reconfirms that the consumer's consideration set is larger than the preference set, because it includes the goods that constitute the reference-price.

The perception of unfairness leads to not buying. In our experiment the clear preference for a small amount of cash (€5) whose reservation value is definitely less than the revealed acceptance of the initial bonus (€9) represents the measure of this "pure" fairness effect. The difference in rejection rates between the two groups decreases the demand more than the standard effect (Daskalopoulou, 2008).

In our experiment, price unfairness typically emerges more clearly than fairness and is mainly driven by loss aversion. This result is partly explained by the peculiar market institution we have adopted for our design, namely the posted-offer price.[27]

Our results, while offering clear confirmation of the model when the price increase is for the product whose demand is analyzed, also suggest the need for caution in their extension to the case of change in the reference-price, in particular: (1) price increases involving reference-price and (2) price decreases.[28] Our intuition is that the role of referencing can differ, at least in degree. This observation dictates the agenda for a possible extension to focus on reference-price modification.

One final remark concerns the antitrust issues that motivated this project and that may be affected by our findings. Our analysis casts a new light on some antitrust cases of suspected collusion among producers of highly differentiated goods or of goods or services in different markets.[29] In these cases standard theory is unconvincing, because it generally treats collusion as a way to "control" demand externalities only among substitute products. So collusion among producers of not substitute goods is something which could not have any justification. But following the model and the experiment of this paper, we can state that a collusive agreement among this sort of producers (aimed to minimize fairness effect through a common price) could be profitable. In this way prices of not interchangeable products can be reciprocally used as a reference for unfair conduct: this sort of cartels could be rather effective in dealing with fairness considerations of consumers and should be in a favorable position to exploit them.

For the same token, the analysis here presented asks for a reconsideration of how an antitrust relevant market must be defined, as this notion should cover also sets of products that are not substitutes (or that are poor substitutes). Yet this change is not as marked as it would appear at first view, at least in principle.

It is a consolidated tenet among antitrust practitioners that an antitrust market is only composed by interchangeable products, the only difficulty of the exercise being the choice of an appropriate degree of substitutability. It has been clarified by Boyer (1979), that in order to delineate an antitrust market we must take into consideration all those products which will be profitably included in a collusive agreement. The SSNIP test, introduced by the US Merger Guidelines (and used almost everywhere) to delineate a market, is based on the same intuition.[30] In this paper we provide a rationale for considering the possibility that a cartel may include some non-interchangeable products: it follows that the definition of relevant antitrust market cannot rest solely on the notion of substitutability.

In principle, we should not expect major changes: the familiar quantitative tests employed for delineating markets are based, among other parameters (e.g. margins), on direct and cross demand elasticities. These indicators are independent on the fact whether products are interchangeable or instead are used for references purposes (that is, if they are bench markers). In practice, however, two stage methods are generally applied. In the first stage market delineators preselect a number of products that could be included in the market. In the second stage, quantitative tests determine which of them are actually included in the market. Benchmark products, which could pass quantitative test based on elasticities of demand, are generally excluded from the outset. But this means that the

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[27] As noted by Plott (1986), the posted-offer institution gives a clear advantage to the seller by comparison with such alternative exchange institutions as double auction and direct bargaining.

[28] To our knowledge no theoretical paper explores this topic: according to Kopalle et al. (1996) the (empirical) effects on consumer behavior of price decrease vs. price increase are not symmetrical.

[29] See the "*Vendomusica*" case before the Italian Competition Authority. We must deal with the same type of problem also when assessing mergers: see the European case Sony/BMG.

[30] Werden (1985).

market definition is inevitably flawed. However, there are cases in which market delineators do not rely strictly on the notion of substitutability, namely when it runs against common sense, as in book and CD markets. This is why our analysis should not have substantial repercussions for these markets. But it does provide a better justification for what is already the standard practice. Our analysis suggests a genuine change only in those cases where the pre-selection of products in the first stage is based exclusively on the notion of substitutability. In conclusion, we want to alert market delineators to the danger that failure to consider possible benchmark products could distort the market analysis.

Acknowledgments

Appendix A. Appendix I

Instructions (**translated from Italian**)
(for all participants)
You are now taking part in an economic experiment on decision-making. Please read the following instructions carefully. During the experiment, you will not be asked to reveal your identity, and your name will not be associated with the decisions you are going to make. You are not allowed to talk or otherwise communicate with the other participants during the experiment. Please turn off your cell phones now.

This experiment is divided into **three stages**: **preliminary stage**, **first stage** and **second stage**.

You can decide to stop the experiment after the preliminary stage.

Preliminary stage: You are asked to choose either €3 in cash or a discount bonus of €9 to buy one CD from the list of 20 hits (see your computer screen). You have three minutes to decide.

If you opt for the bonus you can continue the experiment. If you prefer €3 in cash you stop here.

(Only for the subjects who opt for the €9 bonus)

Please fill out the following "open list" in which you can list your preferred musicians (up to 20).

From here WRITTEN INSTRUNCTIONS ON THE COMPUTER SCREEN.

First stage – Please answer the questions that appear on your computer screen.

Screen 1: Which CD (among the 20 belonging to last month's top twenty hits), would you like to buy with an initial discount of €9 (compared to the internet price of €18)?
Screen 2: Do you want to buy other CDs at the same discounted price of €9 (compared to the internet price of €18)?
Screen 3: Do you want to buy other CDs at more heavily discounted price of €8, so that the bonus is €10 (compared to the internet price of €18)?
Screen 4: Do you want to buy other CDs at still more heavily discounted price of €7,so that the bonus is €11)? (compared to the internet price of €18)?

Second stage – You now see on your computer screen a reduced version of the original list of 20 hits CDs from the first stage.

[For each participant, the list consists of his first choice and all the CDs in which no interest was shown (never selected, "irrelevant CDs"). That is, we eliminated all second-best choices from the original list. We then divided the participants into two groups, paying attention to subjects' "variety preference" and "price sensitivity". We provide two different written instructions to the two groups, via the computer screen.]

The subjects in first group may buy one CD from the modified list at the following prices: €13 (a €5 discount) for the first choice and €9 (the original €9 discount) for each of the irrelevant alternatives.

The subjects in the second group may buy one CD from the modified list for the uniform price of €13 (regardless of whether it is a first choice or an irrelevant alternative).

The subjects (in both groups) who decided not to buy any CD were compensated with €2 (in addition to the €4 participation fee).

Appendix B. Appendix II

A view of the initial screen (in Italian)

I CD elencati sono offerti al prezzo di € 9.00 , inferiore a quello di mercato, pari a € 18.00
Indica , premendo il pulsante corrispondente, il titolo del CD che compreresti a questo prezzo.
E' possibile un'unica scelta

DOL PUSSYCAT: Pcd — Compra	JESSE MCCARTNEY: Beautiful soul — Compra
PINK: I'm not dead — Compra	BOB SINCLAR: Western dream — Compra
JOHNSON JACK: Curious george — Compra	MARY J BLIGE: The breakthrough — Compra
DAVID GILMOUR: On an island — Compra	BLACK EYED P: Monkey business — Compra
GOTAN PROJECT: Lunatico — Compra	VASCO ROSSI: Buoni o cattivi — Compra
ANDREA BOCELLI: Amore — Compra	LIGABUE: Nome e cognome — Compra
RIHANNA: A girl like me — Compra	SHAKIRA: Oral fixation vol.2 — Compra
PLACEBO: Meds — Compra	PEARL JAM: Pearl jam — Compra
EROS RAMAZZOTTI: Calma apparente — Compra	TOOL: 10.000 days — Compra
CAPAREZZA: Habemus capa — Compra	KNOPFLER/EMM: All the road running — Compra

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