If the same is not the same - The influence of the unit of measurement on the valuation of a unit price

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If the same is not the same
The influence of the unit of measurement on the valuation of a unit price

Due to legal requirements, unit prices are a ubiquitous phenomenon. The respective legal norms leave a certain freedom of choice with regard to the reference unit. Nevertheless, research on the effect of alternative measurement units on consumer behaviour is still in its infancy and a literature review reveals inconclusive findings. Investigating the product category bottled beer and applying a Choice Based Conjoint experiment, it is discovered that a big compared to a small size unit of measurement leads to a significant shift of importance towards the product attribute price at the expense of the brand. In addition, consumers react more sensitively to price changes. At the strategic level, a retailer can use these insights to sharpen its positioning through a suitable unit price measure. When making operational decisions, retailers should bear in mind that the reference unit influences the likelihood of purchase, the scope for price increases and the opportunities for up-selling.

Conjoint Measurement, Price Perception, Unit Pricing

Pricing & Promotions

1. Introduction

Due to legal requirements, declaration of a unit price became ubiquitous in many countries since the 1970s (Fecher, Robbert, & Roth, 2019). A unit price illustrates the price of a pre-packed product by a unit of measure, such as € per item, $ per 1 kg or £ per 1 l, commonly in addition to the standard product price. The legislator intended to simplify comparisons between products of different sizes and prices, increasing the chance of a more informed and profound purchase decision (Isakson & Maurizi, 1973; Lamont, Rothe, & Slater, 1972).

The legal framework usually leaves some freedom of choice regarding the unit of reference (Fecher et al., 2019). E.g., the unit price of a liquid cleaning agent might in the European Union be indicated per application, per 1 l or per 100 ml. Even in case of the same absolute price a different unit of reference will lead to a different nominal value of the unit price. Despite that unit pricing has attracted a great deal of interest there is both limited knowledge and contradictory findings on the impact such a shift in the unit of reference has on behavioural reaction (Fecher et al., 2019; Roth & Himbert, 2015; Yao & Oppewal, 2016b, 2016a). In addition, the present studies capture this impact only by means of direct questions. The potential of conjoint measurement to provide additional insights in the context of price-related issues (Geiger, Dost, Schönhoff, & Kleinaltenkamp, 2015; Kostyra, Reiner, Natter, & Klapper, 2016; Meyer, Shankar, & Berry, 2018; Rao, 2015) has been neglected so far.

The aim of this paper is to narrow the outlined research gap. First, the relevant literature on the effect of different units of reference is reviewed. Then, hypotheses are derived, the research methodology is discussed and findings are presented. The paper concludes with implications, limitations and suggestions for future research.

2. Literature Review

Since the 1970s, the research area unit pricing has attracted a great deal of interest. A comprehensive overview of the existing literature on unit pricing is compiled by Roth and Himbert (2015) who structure the research along a cognitive process as illustrated in Figure 1.

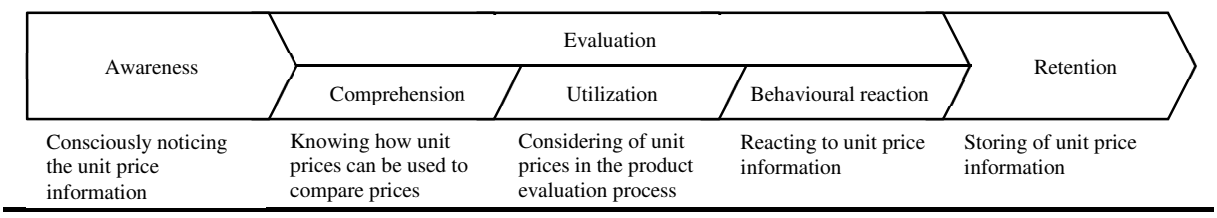

Figure 1. Cognitive process of processing unit prices

In comparison to the other research fields, research on the effect of different units of measurement on consumers' behavioural reaction is still in its infancy (Roth & Himbert, 2015). On top, its findings are inconclusive so far (Fecher et al., 2019). The first comprehensive study on this topic by Kwortnik, Creyer, and Ross (2006) employs a three-factor between-subjects design to assess whether a usage- or a measure-based unit pricing is more suitable. Out of five product alternatives from the product categories (I) laundry detergent and (II) breakfast cereal respondents were asked to select their favourite option. Whether or not they have chosen the one offering the highest (a) usage- or (b) measure-based value served as the dependent variable of a logistic regression. According to the empirical findings, a usage-based unit price decreases the likelihood of selecting the laundry detergent with the best measure-based value (Ib). Furthermore, a measure-based unit price increases the likelihood of selecting the breakfast cereal with the best measure-based value (IIb) and decreases the likelihood of selecting the option with the best value-based price for both product categories (Ia and IIa). At the 5% level, all other effects were not statistically significant.

A one-factorial between-subjects design with two different unit price measures (per 100 g / ml vs. per 1 kg / l) is used by Roth and Himbert (2015). They consider unpacked- (tomatoes and salami) as well as pre-packed (strawberry jam and wall paint) products. Indices for price-level perception, quality perception as well as purchase intention act as endogenous variables, quality consciousness and unit price usage as control variables. In essence, the postulated hypotheses are supported by the empirical findings: a bigger size unit of measurement leads to a less favourable price-level perception. The latter variable in turn positively influences the purchase intention, both directly as well as mediated by quality perception. Nevertheless, this is not a universal relationship. The influence of the unit of measurement on price-level perception is only significant in case of a quality conscious customer (tomatoes) and a high unit price awareness (wall point) respectively. Furthermore, price-level perception impacts quality perception with tomatoes only if unit price awareness is low.

Yao and Oppewal (2016a) define a scenario simulating a shopping situation in which consumers were asked to purchase three low-involvement grocery items (frozen baby peas, canned tomatoes, olive oil). For each product group, there were three options, one with a low, one with a medium and one with a high price. The three-group between-subjects design consisted out of a control (unit price absent) and two experimental conditions, one in which the unit prices were expressed in a small (per 100 g / ml) and one in which they were expressed in a big (per 1 kg / l) size unit of measurement. In contrast to the other studies mentioned, a switch in the unit of reference did not impact product choice.

Shirai (2017) compares the impact of temporal reframing of prices (e.g., per day), usage-based (e.g., per serving) as well as measure-based (e.g., per 2 gram) unit pricing among others on price perception, quality perception and purchase intention. 201 college students participated in a controlled experiment involving a 2 (high vs. retail price) x 4 (the mentioned reframed price forms and a control) between-subjects design. Prepacked tea leaves were selected as a product stimulus. The units of reference have been defined in a way so that the numerical value of the unit price kept unchanged. In terms of price perception, a temporal reframing of prices outperforms a measure-based unit price and, like a usage-based unit price do, the control condition. Both, a temporal reframing of prices as well as a usage-based unit price increase the purchase intention compared to a measure-based unit price and the control condition.

Three studies which investigate the influence of different unit price measures (per 100 g / ml vs. per 1 kg / l) are presented by Fecher et al. (2019). Each of the three experiments consisted of a hypothetical shopping task. In addition to the two different units of measurement one additional factor was considered in each of the studies: the absence vs. presence of a retail price (study 1) and in total three different packaging sizes (studies 2 and 3). The small as well as the large package sizes were close to a unit of measurement (125 g / ml or 975 g / ml), the medium package sizes were far away (450 or 550 g / ml). Price-level perception and purchase intention served as dependent, familiarity with and purchase frequency within the product category as control variables. In the main, the study findings confirm the "measurement-unit effect, such that consumers perceive unit prices stated in larger measurement units (e.g., per kg) as higher than unit prices stated in smaller measurement units (e.g., per 100 g)" (Fecher et al., 2019, p. 134). However, this only applies in the case of medium package sizes.

3. Hypotheses Development

The influence of the framing of price information on consumers' purchasing decisions has been proven for about four decades (Tversky & Kahneman, 1981). A unit price as a possible framing consists of two components: a numerical value and a unit of reference. Empirical research shows that consumers tend to focus on the former and largely ignore the later (Bagchi & Davis, 2016; Bagchi & Li, 2011; Fecher et al., 2019; Pandelaere, Briers, & Lembregts, 2011). Therefore, individuals perceive a numerical value measured on a large scale (e.g., per kg) to be larger than if its measured on a small scale (e.g., per g) (Burson, Larrick, & Lynch, 2009; Pandelaere et al., 2011). Although the exact mechanism underlying this so-called numerosity effect is still vague, it emerges because of inattentiveness to and a heuristic processing of

numerical information (Fecher et al., 2019; Lembregts & van den Bergh, 2019; Monga & Bagchi, 2012; Pandelaere et al., 2011; Schley, Lembregts, & Peters, 2017).

Due to the numerosity effect, it can be expected that a unit price indicated in a large unit of measurement (e.g., € 1.40 per 1 l) will be perceived as higher than the same product price indicated in a small unit of measurement (e.g, € 0.14 Euro per 100 ml) (Bagchi & Davis, 2016; Fecher et al., 2019; Roth & Himbert, 2015). In the context of a purchase decision, this effect can influence the consumer's choice in two ways. On the one hand, a price perceived as high usually attracts a higher degree of an individuals' attention. Accordingly, it is to be expected that the relevance of the price for the purchase decision increases. This leads to the hypotheses: The relative importance of the product attribute 'price' is higher when the unit price is indicated in a large compared to a small unit of measurement (H_I).

On the other hand, the numerosity effect does not only apply to the numerical value itself, but also to the valuation of differences between numerical values (Pandelaere et al., 2011). In case a unit price is indicated in a large unit of measurement, the gap between different levels of the attribute 'price' is therefore perceived as bigger than in the case of a small unit of measurement. Consequently, we postulate the hypothesis: In case of a unit price 'per 1 l' respondents react much stronger to the different levels of the attribute 'price' than customers confronted with a unit price 'per 100 ml' (H_{II}).

4. Research Design and Empirical Findings

4.1 Research approach and sample characteristics

In preliminary in-depth discussions, a suitable product category and key attributes used by consumers to evaluate products in this category were selected. From a list of five options, 'bottled beer' was chosen as a reference and 'price', 'brand' (implicitly including 'taste'), 'alcohol content' as well as 'size of packaging unit' as key attributes. The relevant levels for each attribute (see Table 1) were determined based on a systematic analysis of the offering in the relevant stores, official statistics for the product market as well as websites from the major players in the beer market.

Product attribute	Alternative levels
Brand	Becks / Warsteiner / Radeberger / Pfungstätter / Bitburger / Oettinger
Price	€ .09 / .14 / .19 / .23 / .27 per 100 ml or € .90 / 1.40 / 1.90 / 2.30 / 2.70 per 1 l
Alcohol content	4.0% / 5.0% / 6.0% / 7.0%
Size of packaging unit	.33 l / .50 l

Table 1. Levels per product attribute considered in the own study

The aforementioned parameters of the research design were transferred to a Choice Based Conjoint (CBC) experiment. Each participant was randomly assigned to one out of the two alternative conditions (€ per 1 l vs. € per 100 ml). The nominal value of the unit price was adjusted accordingly so that the relative unit price kept unchanged (e.g., € 1.40 per 1 l was converted to € 0.14 per 100 ml). Care has been taken to ensure that neither the numerical value nor the reference unit stand out (Monga & Bagchi, 2012). The answers to the quantitative main study were collected online. Each choice task consisted out of three product concepts specified in terms of their attribute level as to the four above mentioned product attributes. In addition, selected socio-demographics were recorded.

After eliminating incomplete data sets, the data file consisted of 123 CBC experiments. In line with the main target group of the product category beer, the male respondents (61.0%) outweigh the female respondents (39.0%) by a factor of 1.6. As a main activity, 39.8% of the respondents attended school, a university or were undergoing vocational training and 55.3% were employed. Their average age was 33.54 years (SD = 14.25). 11.4% of participants did not consume beer at all, 35.0% less often than once per week, 33.3% once or twice a week, 20.3% at least three times a week. With none of the mentioned socio-demographic variables there is a statistical significant difference between the two sub-samples (gender: $\chi^2(1) = .692$; p = .41; main activity: $\chi^2(2) = 2.158$; p = .34; age: $t(121) = .068$; p = .95; consumption pattern: $\chi^2(3) = 1.267$; p = .74).

4.2 Importance of key product attributes

Overall, ‘brand’ is the most important attribute of ‘bottled beer’ (see Table 2). ‘Price’ takes second place with 17.5 percentage points less of importance than ‘brand’, closely followed by ‘alcohol content’. ‘Size of packaging unit’ plays only a minor role in the purchase decision.

With regard to the extent to which the different product attributes contribute to the perceived customer benefit, the two sub-samples do not differ statistically significantly for the two attributes ‘alcohol content’ ($t(121) = -1.564$; p = .12) and ‘size of packaging unit’ ($t(121) = .220$; p = .83). In contrast, there is a statistically significant difference with regard to the importance of the product attributes ‘brand’ and ‘price’. In case ‘per 1 l’ instead of ‘per 100 ml’ is used as a reference unit, the importance of ‘price’ increases from 20.4% to 34.3% ($t(121) = 5.196$; $p < .01$). This effect is essentially at the expense of the attribute ‘brand’, whose importance for the purchase decision decreases from 49.3% to 38.7% ($t(121) = -3.244$; $p < .01$). In other words, indicating the unit price with a large nominal value increases the importance of the ‘price’ for the purchase decision. The outlined findings support H_I.

Product attribute	Total sample	'l' sub-sample	'ml' sub-sample
Brand	44.4	38.7	49.3
Price	26.9	34.3	20.4
Alcohol content	21.8	20.0	23.3
Size of packaging unit	7.1	7.2	7.0

Table 2. Importance of key product attributes overall and per sub-sample (in percent)

4.3 Part-worth utilities per level of product attribute 'price'

The part-worth utilities calculated by CBC implicitly reflect the relative importance of the respective attribute. In order to eliminate this effect, which was already discussed in the previous section, the original part-worth utilities of the attribute 'price' had to be calibrated. At the level of each individual the calibrated part-worth utilities ranged from 0 (least valued attribute level) to 100 (most valued attribute level) index points.

A split-plot ANOVA reveals that there is a statistically significant interaction between the different levels of the unit price and the unit of reference (Huynh-Feldt $F(3.166, 383.035) = 6.094$; $p < .01$; partial $\eta^2 = .048$). Furthermore, the main effect of the different price levels on the utility value is significant (Huynh-Feldt $F(3.166, 383.035) = 37.569$; $p < .01$; partial $\eta^2 = .237$). Whereas the differences among the different price levels are not statistically significant for the first three price levels, they are statistically significant at the 1%-level in all other cases. Within a range up to '€ .19 per 100 ml / € 1.90 per 1 l' the respondents are price-insensitive. An exception is the 'ml' sub-sample, where the difference between the lowest and the second lowest price level is statistically significant ($t(65) = -2.009$; $p < .05$).

As documented in Table 3, a unit price 'per 1 l' increases price-sensitivity significantly compared to a unit price 'per 100 ml'. At least within the 'ml' sub-group the lowest price level raises doubt about product quality. This finding implicitly confirms that '€ .09 per 100 ml' is perceived as a lower price than '€ .90 per 1 l'. The slump in utility, which comes with exceeding the range of price-insensitivity, is much more pronounced in the 'l' than in the 'ml' sub-sample. Beyond that range of price-insensitivity, the findings support H_{II}.

Level	Unit price	'l' sub-sample	'ml' sub-sample	Significance of difference
1	€ .09 per 100 ml*	73.23	54.02	$t(121) = 2.582$; $p < .05$
2	€ .14 per 100 ml*	78.22	65.41	$t(121) = 2.250$; $p < .05$
3	€ .19 per 100 ml*	70.05	66.80	$t(121) = .544$; $p = .54$
4	€ .23 per 100 ml*	34.67	48.25	$t(121) = -2.055$; $p < .05$
5	€ .27 per 100 ml*	13.97	33.30	$t(121) = -3.085$; $p < .01$

* Or the analogue value in '€ per 1 l' (see Table 2)

Table 3. Mean of calibrated part-worth utilities per level of product attribute 'price'

5. Implications

This study complements and advances current research on the effect of alternative units of measurement on consumer behaviour, in particular on the relevance of the product attribute ‘price’ for the purchase decision as well as price sensitivity. For the first time a Choice Base Conjoint experiment is used to investigate this effect. First, it confirms the relevance of the reference unit for the effect that a unit price has on consumer behaviour. Individuals perceive a product as more expensive when its unit price is specified ‘per 1 l’ than when it is specified ‘per 100 ml’. Second, this shift stems from two sources: an increase in the importance of the product attribute ‘price’ and an increasing price sensitivity induced by a big sized reference unit.

Retailers should take these insights into account in both strategic and operational decisions. At the strategic level, a targeted selection of the unit of measurement supports the positioning of the retailer. Small unit price measures are suitable to signal the price competitiveness of a retailers' offer. This approach is particularly recommended for companies that compete via a low price, e.g., discount stores. Conversely, prices that are perceived as high due to a large unit of reference can signal exclusivity and quality and thus promote a premium image. This is an advantageous positioning for delicatessen, for example.

At the operational level, a small unit of measurement offers three kinds of opportunities for retailers. Firstly, a price perceived as low increases the purchase probability and thus the volume sold. Secondly, a price increase is perceived as comparatively less serious, which increases the scope in this respect. Thirdly, price differences perceived as comparatively low facilitate up-selling. The latter two effects generally have a positive impact on profitability.

For legislators, it is necessary to critically weigh conflicting objectives for society as a whole. One of them is to make it easier for consumers to make informed and profound purchasing decisions. Price is an essential parameter for this, quality differences are another. A further objective is to promote product and process innovation and thus progress. A (too) strong price orientation can be counterproductive, especially with regard to qualitative growth. This also applies, for example, to concentrated products, which may prove to be ecologically sensible but often lose out in unit price comparisons (Kwortnik et al., 2006). An un-reflected use of this instrument therefore carries the risk of misallocation for society as a whole.

6. Limitations and Suggestions for Future Research

This study explores the impact of different units of measurement on the choice between various product alternatives, in particular the importance of the product attribute price and price

sensitivity. The application of a CBC experiment put the test subjects in a concrete mindset and a realistic situation. This is considered a prerequisite for the occurrence of a numerosity effect (Bagchi & Davis, 2016) and increases the external validity of the empirical findings. The choice of the product category 'bottled beer', for which no default for the unit of reference exists according to the pre-study, ensured that the numerosity effect is not superimposed by this mentally anchored reference unit (Lembregts & Pandelaere, 2013).

However, the subject deserves further consideration. The quantitative data refers to a single product category. Further research should take additional product segments into account. In addition, the comparison of heavy and light users, of consumers with little or comprehensive product knowledge (Shirai, 2017) as well as different levels of involvement could be interesting fields of research. Furthermore, considering age, the level of education and personality variables, e.g., specific behaviour patterns or the preferred life style, as moderators of the effect that emanates from a change in the unit of measurement could be of interest. From a managerial perspective, examples for future explorations could consist in simultaneously testing the impact of different reference units on competition between retailers and between brands within a retail store. Balancing and optimizing these two levels should prove to be a complex challenge.

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