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Randomised controlled experiment on the effect of disclosing 'true' prices on food choice

Randomisiert-kontrolliertes Experiment zur Wirkung der Offenlegung „wahrer" Preise auf die Lebensmittelauswahl

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Summary

Agricultural food production generates external costs, whose extend depends on production practices. This study addressed the question of whether disclosing external environmental costs of food production in addition to the sales price could encourage consumers to make more sustainable food choices. In a randomised controlled online experiment organic and conventional milk were used as an example. The results showed that participants who were additionally informed about external environmental costs and resulting 'true' prices chose organic milk, i.e. the milk with the lower external costs, significantly more often than participants who received information on the sales prices only.

Keywords: externalities food production, hidden costs, organic milk, conventional milk, willingness to pay

Zusammenfassung

Die landwirtschaftliche Lebensmittelproduktion verursacht externe Kosten, deren Höhe vom Produktionsverfahren abhängt. In dieser Studie wurde der Frage nachgegangen, ob die Offenlegung externer Umweltkosten der Lebensmittelproduktion zusätzlich zum Verkaufspreis die Verbraucher zu einer nachhaltigeren Lebensmittelauswahl bewegen könnte. In einem randomisierten kontrollierten Online-Experiment wurden biologische und konventionelle Milch als Beispiel verwendet. Die Ergebnisse zeigten, dass Teilnehmer, die zusätzlich über externe Umweltkosten und die daraus resultierenden "wahren" Preise informiert wurden, signifikant häufiger Biomilch wählten, d.h. die Milch mit den geringeren externen Kosten, im Vergleich zu Teilnehmern, die nur Informationen über die Verkaufspreise erhielten.

Schlagworte: Externalitäten, Lebensmittelproduktion, versteckte Kosten, Biomilch, konventionelle Milch, Zahlungsbereitschaft

1 Introduction

Agricultural food production, with its up- and down-stream industries, generates various external effects. External effects exist when an actor's utility function is affected by the behaviour of another actor, who does not consider these effects of the behaviour in his or her decision-making process. Externalities constitute a kind of market failure, since social costs and benefits of a behaviour are not reflected in market prices - neither the producer nor the consumer of a commodity has to account for them (Verhoef, 1994; Rocha, 2007)

Novikova (2014) outlines positive and negative externalities of agricultural food production in the cultural, social, environmental, and welfare dimensions. Dependent on the production method, agriculture can enhance the aesthetics of landscapes and provide areas for recreation; maintain cultural heritage, viability of rural areas and food security; contribute to biodiversity, resilience to weather events and climate change, and quality of natural resources; and to welfare of inhabitants and livestock (Novikova, 2014; Jongeneel et al., 2014; Pretty et al., 2001). Positive externalities are usually provided by extensive farming systems (Novikova, 2014) - mostly in the local to regional context. Intensive methods of agricultural production, transport and processing of agricultural products and foods, are most often not as beneficial to society in the local and regional context. In a global perspective, all types of agricultural land use for food production also bear "carbon opportunity costs" (COC). COC refer to the forgone climate protection effect through potential regeneration of natural vegetation on a given land used for food production (Searchinger et al., 2018). Therefore, intensive farming methods might be linked to lower climate effects based on a per product unit basis because less land is needed for producing a product unit compared to extensive systems (Searchinger et al., 2018) and have short-term food security effects. Still, on a per area unit basis, intensive systems are associated with negative impacts on climate, and considering additional impacts on landscape, environment, crop genetic diversity, and human health and animal welfare, this is likely true per product unit as well. (Novikova, 2014; Sukhdev et al., 2016). If these external effects are not internalised and reflected in product prices, the market will be distorted by signalling consumers that sales prices based on private costs of food are lower than they are to society. In this way food purchases are encouraged that are costly to society even if private benefits to the industry can be substantial (Schläpfer, 2020).

Even if the concept of externalities is relatively clear, it is difficult to capture all external effects of food systems and to attach monetary values to them (Jongeneel et al., 2014; Michalke et al., 2020). Nevertheless, since the beginning of the 21st century, there have been different approaches to calculate external costs of agricultural production, with a focus of monetarising environmental impact (Pieper et al., 2020). Recent work by Michalke et al. (2020) and Pieper et al. (2020) that compares the environmental costs of certain organically and conventionally produced food shows that, within their conceptual framework, conventional animal-based products generate the highest external environmental costs followed by organic animal-based products. Plant based products generate considerably lower external environmental costs. The external costs calculated by Michalke et al. (2020) include the impacts of nitrogen, climate gases, energy, and land use change determined at certain temporal reference points (Michalke et al., 2020; Pieper et al., 2020). A German discounter used the calculations of the aforementioned authors as a basis to disclose not only the sales prices but also hidden, i.e., external, costs and resulting 'true' prices for some products in one of its stores (Michalke et al., 2020). By disclosing these hidden environmental costs, the discounter aims to make the costs of food production more transparent for customers and enable informed purchasing decisions (PENNY, 2020).

Providing information on externalities of food production might be a way to influence purchasing decisions in favour of more sustainably produced products, which would be beneficial for society. To date, however, it is not clear whether this increased transparency could indeed influence purchasing decisions. This study closes this research gap by investigating the effects of displaying additional information about hidden costs and 'true' prices on food choices, using organic and conventional milk as examples. In a randomised controlled online experiment, a subset of participants was provided with additional information about the environmental externalities of milk as calculated by Michalke et al. (2020), and the other subset of participants did not receive this information. We hypothesized that displaying the information on environmental externalities would influence the choice of milk in favour of the milk with the lower externalities, i.e., in favour of organic milk.

2 Methods

A randomised, controlled online experiment was conducted in January and February 2021 using the survey software LimeSurvey Enterprise. To determine the influence of information on hidden costs and resulting 'true' prices, i.e., sales price plus hidden costs as calculated by Michalke et al. (2020) on the choice of milk, participants were randomly allocated by the software to one of two groups (split ballot). Participants of each group were asked to choose between conventional and organic milk. Participants of group 1 only received information on sales prices of conventional and organic milk; participants of group 2 received additional information on hidden environmental costs and the resulting 'true' prices of conventional and organic milk (see table 1). For the participants in group 1, the experiment was introduced with the following question: "Imagine you were offered the following two products while shopping. Which one would you choose?". For the participants in group 2, the question was expanded: "Imagine you were offered the following two products while shopping. The price you have to pay, additional hidden environmental costs and the resulting actual 'true price' are displayed. Which of the two products

Table 1: Information participants received in the experiment

	Group 1		Group 2	
	Conventional milk	Organic milk	Conventional milk	Organic milk
Sales price (€/l)	0.72	1.09	0.72	1.09
Hidden costs (€/l)	Not displayed		0.89	0.75
Hidden costs (%)	Not displayed		122	69
'True' price (€/l)	Not displayed		1.61	1.84
Display of the options in the questionnaire			 	

Source: Own research.

would you choose?". The two types of milk were displayed in random order within in each group. After completing the experiment, the participants of group 2 were asked whether they would be willing to pay the hidden environmental costs.

The questionnaire contained accompanying questions on sociodemographic data and food purchasing and eating behaviour. Furthermore, the participants were asked to rate the importance of various criteria for food purchasing on a 5-point scale. Answering these accompanying questions was voluntary.

Participants were recruited through social media channels (WhatsApp and Facebook). Of the 507 respondents who completed the survey, speed responders with a survey completion time < 4 min (n = 25) and participants with inconsistent response behaviour (n = 6) were excluded, resulting in 476 responses available for statistical analysis of the experiment.

Statistical analyses were done with Stata, release 16 (StataCorp LLC, 2019). To verify the equality of the two groups and thus the success of the randomised assignment of the subjects to the groups, statistical tests tailored to the data were used in each case. The tests are specified in the reporting of the respective results (section 3). All analyses were conducted using the maximum number of responses available.

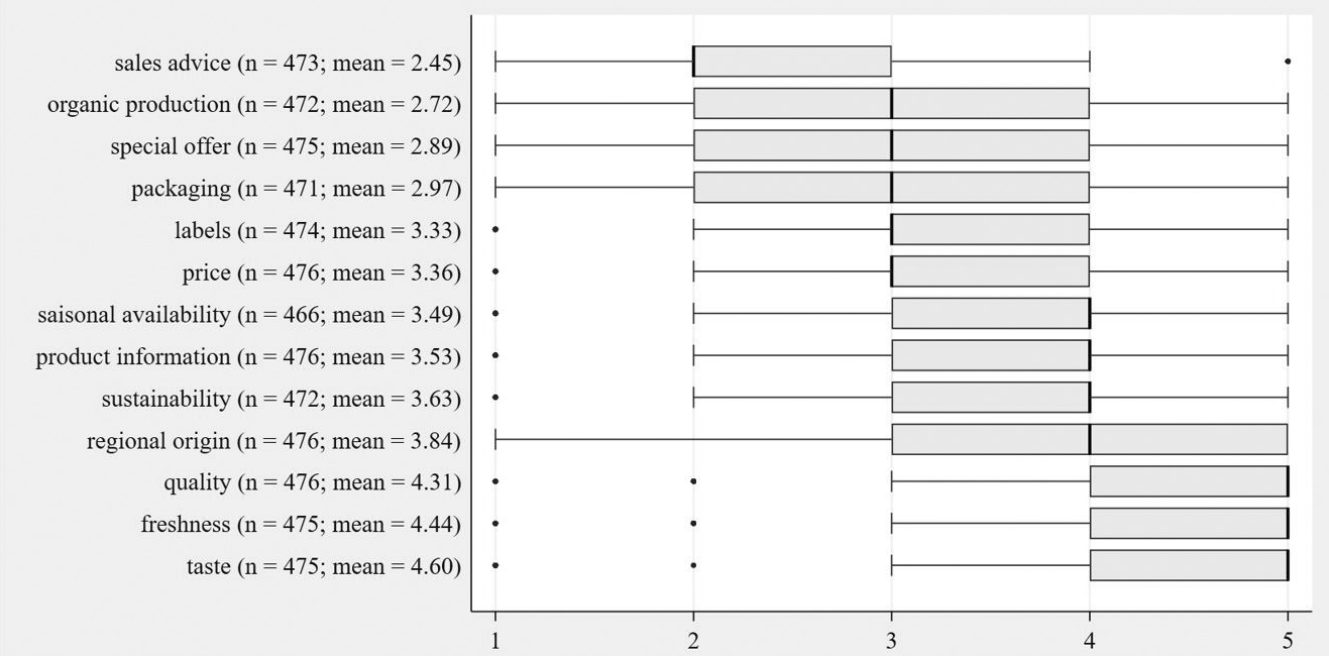
3 Results

The sample consisted of 52 % male and 48 % female participants (n = 467) with a mean age of 30.19 (± SD 13.27) years (n = 475). With a share of 76.4 %, the majority of the participants reported living in rural environments; the remainder lived in urban environments (n = 471). The highest educational attainment was secondary school leaving certificate or below for 19.2 % of the participants, 56.6 % had Abitur and 24.1 % of the participants held an academic degree (n = 468). Compared to the German population, the sample included slightly more men. The participants lived more often in rural areas, had more often a higher level of education and were younger (Destatis, 2021).

Supermarkets were the most important place to buy food for 59.1 % of the respondents, followed by discounters with 16.3 %, food specialist shops (e.g. bakeries, butcher shops) with 15.9 % and farm stores, weekly markets and health-food stores together with 8.7 % (n = 472). With a share of 87.5 %, the vast majority of respondents stated to have no specific eating behaviour, the rest of the respondents partially or completely abstained from food of animal origin (n = 473).

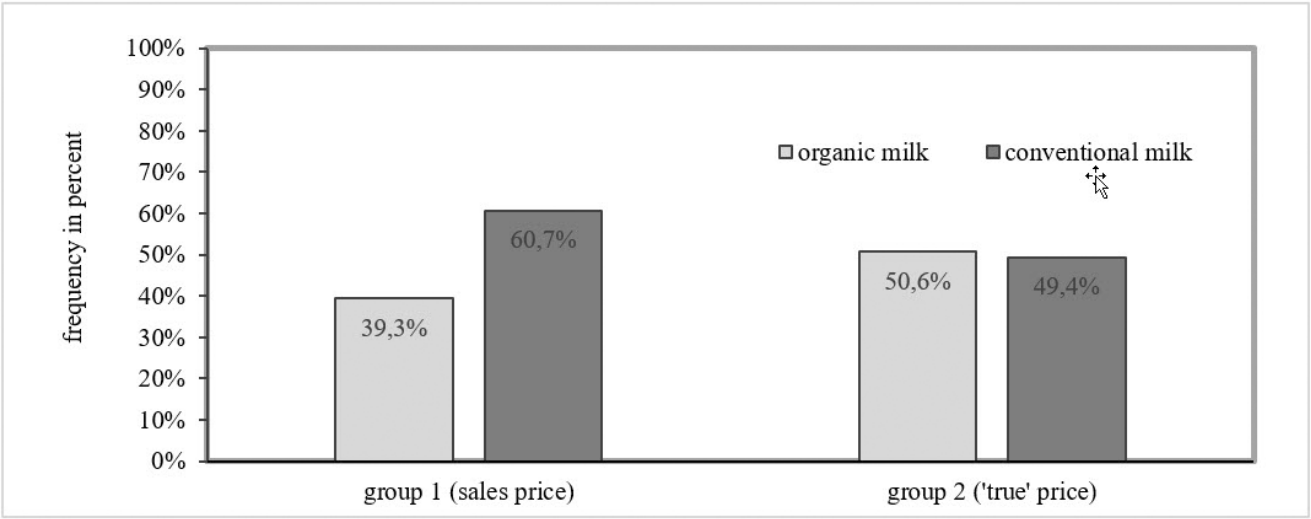
Participants' importance ratings of food purchasing criteria are displayed in Figure 1. The most important criteria were quality, freshness and taste with a median of 5. The least important criterion was sales advice, with a median of 2.

Figure 1: Responses to the question "How important are the following criteria to you when purchasing food?" on a scale from 1 (very unimportant) to 5 (very important).



Note: The box of the box plots indicates the lower and upper quartile, the thick line represents the median, the whiskers include all data points within 1.5 interquartile range of the nearer quartile and stop at adjacent values. Points beyond the whiskers are outliers. Mean values are reported in the legend.
Source: Own research.

Figure 2: Choice of milk depending on price information group 1 (n = 239): sales prices only; group 2 (n = 237): additional information on external costs and 'true' prices); Chi-Square test, p < .05



Source: Own research.

The two groups participants were randomly assigned to for the experiment did not differ in gender [Chi-Square-test, X^2 (1) = .78, p = .38], age [T-test, t (473) = .09, p = .93], living environment [Chi-Square-test, X^2 (1) = .36, p = .55], educational level [Chi-Square-test, X^2 (2) = .05, p = .98], preferences for the place to buy foods [Chi-Square-test, X^2 (3) = 1.73, p = .63] and eating behaviour [Chi-Square-test, X^2 (1) = .18, p = .66]. They also did not differ in their ratings of importance of the food purchasing criteria (Mann-Whitney-U-test; p > .05 for each item).

Figure 2 shows the results of the experiment. Group 1 consisted of 239 participants, group 2 of 237 participants. In group 1, where only the sales prices of organic and conventional milk were presented, the proportion of participants choosing organic milk amounted to 39.3 %. In group 2, where additional information about hidden environmental

costs and 'true' prices was given, 50.6 % of the participants chose organic milk. The Chi-Square test of independence showed a significant association between group (i.e., kind of information) and milk preference [X^2 (1) = 6.14, p = .013, φ = - .114].

Most of the participants of group 2 stated that they would be willing to pay the hidden costs. Thereby, the chi-square test revealed a significant association between the choice of milk (conventional or organic) and the participants' willingness to pay the hidden costs [X^2 (1) = 10.52, p = .001, φ = - .211]. Of the participants who preferred conventional milk, 69.2 % claimed that they would pay the hidden costs. Among the participants who preferred organic milk, this proportion was 86.7 %.

4 Discussion

The aim of the study was to investigate the effects of disclosing external environmental costs of food production on purchasing decisions. The results of the online experiment confirmed our hypothesis that informing potential customers about these external costs would influence their decision in favour of more sustainably produced foods, i.e., foods with lower external costs. In the experiment, disclosure of hidden costs increased the proportion of participants who chose organic milk from 39 % to 51 %. The vast majority of participants who were informed about the hidden costs in the experiment, stated a willingness-to-pay for hidden costs.

The proportion of participants who preferred organic milk was considerably higher in both groups than the market share of organic milk. In Germany, organic milk accounted for only 11.6 % of total sales of drinking milk in the period from March to October 2020 (Richarts and Thiele, 2020). This discrepancy between intentions and actual behaviour, also referred to as the intention-behaviour gap, has been repeatedly addressed in the literature related to ethical food consumption (e.g., Qi et al., 2020; Sultan et al., 2020). The extent of this intention-behaviour gap mentioned by Carrington et al. (2014) is similar to our findings. Individuals tend to overestimate their self-reported behaviour (Moser, 2015) suggesting that the results of our study represent the stated behavioural intention of the participants rather than their revealed purchasing behaviour. Moreover, in surveys that include questions about the purchase of organic food, respondents may not only overestimate their preferences for organic food, but also feel pressure to answer in a socially desirable manner. Because organic production is considered socially desirable (Wheeler et al., 2019), results may be biased in favour of organic foods. In our experiment, this might be more salient in group 2, as this group was informed about the hidden costs of conventional and organic food.

Both groups of participants did not differ in their participant-specific variables, i.e., socio-demographics, food purchasing and eating behaviour, and assessment of food purchasing criteria, indicating that the internal validity of the study is high. The equivalence of the two participant groups allows us to assume that the results of the experiment were an effect of the experimental manipulation (Koch et al., 2019). The additional information about hidden costs and 'true' prices of the two types of milk increased significantly the frequency of choosing organic milk, which had lower hidden costs than conventional milk. This fits to recent research showing that providing actionable information on environmental benefits of products can strengthen intentions to purchase organic products (Aitken et al., 2020). However, the phi-coefficient indicates that in our study the association between the type of information and the choice of milk was rather weak. This might be due to the fact that the 'true' price of organic milk in the experiment was still higher than that of conventional milk, even if the hidden costs were lower. The consideration that a product cannot be more sustainable if the 'true' price is higher after adding hidden environmental costs could have played a role here. The term 'true' price could have been misleading for the participants and given the impression that milk production does not generate externalities beyond those included in this price. It is possible that the result would have been clearer if the 'true' price of the organic milk had been lower than that of the conventional milk by disclosing further hidden costs that have not yet been included in the calculation of the 'true' price. Examples of externalities not considered in the 'true' price calculation here are impacts on biodiversity, on human health through possible differences in nutritional value, impacts of pesticide use in fodder production, use of GMO-feed, antibiotics for treatment of animal diseases and on animal welfare (Michalke et al., 2020; Harvey and Hubbard, 2013; Phalan et al., 2011). But also, carbon opportunity costs are missing, which in case of inclusion might favour conventional milk (Searchinger et al., 2018).

It can be assumed that most of the participants were not aware of the external costs arising from the production of food or how high these costs are before participating in the study. The majority of participants stated to be willing to pay directly for the externalities of the milk they choose and would thus accept a fairer allocation of costs based on the polluter-pays principle (Pieper et al., 2020). The high level of agreement might have resulted from the disclosure of hidden costs and the associated increase in participants' environmental knowledge. Informing consumers about external effects of food production and thus broaden their knowledge can increase their willingness to pay (Katt and Meixner, 2020; Rousseau and Vranken, 2013). However, the claim that most participants state to pay the hidden costs can only be made for the prices used in the experiment. Including further externalities might lead to different results, in particular if the 'true' price would then be considerably higher than the current sales price. In addition, participants tend to overestimate their self-reported willingness to pay (Reynolds et al., 2015; Moser, 2015). This suggests that the proportion of participants who would actually pay for external costs of milk might be lower.

In order to better assess the results of this study, some limitations of the study need to be mentioned. Even though the

study has a high internal validity, the external validity might be limited due to the non-random sampling and thus the results may not be representative for the general population. In particular, the high level of education of the participants should be mentioned here, which might enable them to better understand the issue of external costs. Also, the younger age of the sample might bias towards higher intentions for organic product choices as younger people are more concerned about sustainability issues. Therefore, younger people might have had a better understanding of the concept of external costs. Moreover, the study does not allow conclusions to be drawn about the effect of the 'true' price information in other countries. Future research could overcome these limitations by using representative samples in different countries. In addition, participants were not informed about the categories of environmental costs that are included in the calculation of hidden costs, which might be perceived as non-transparent. In future studies, detailed information on hidden costs could be given and further external costs beyond environmental costs could be included. Another possibility would be to control for this factor by asking participants for their understanding of possible hidden costs. We used a hypothetical online setting, so the study might overestimate willingness to buy and willingness to pay. Experimental setups in which participants have to make a real purchase at the end could help to avoid overestimating willingness to buy and pay (Breidert et al., 2006). Complementary neuroeconomic methods such as eye-tracking and fNIRS might be used to analyze the perception of this information in more depth. The results are limited in their interpretation to the fixed sales prices for organic and conventional milk used in the experiment; no conclusions can be drawn about choice behaviour under alternative price configurations, as would be possible with choice experiments. Finally, it could be examined whether the term 'true' price is appropriate. Qualitative studies might be a first approach to investigate this.

5 Conclusions

This study shows that information on external costs and resulting 'true' prices could influence consumers' purchasing decisions in favour of more sustainably produced food products. In addition, the study indicates an intention to directly pay for external costs of food and thus to take account of the polluter-pays principle. Transforming intentions into action might depend on the specific design how additional monetary means through 'true' prices will be shared. This has some implications for politics and marketers. On the one hand, increased transparency through the disclosure of hidden costs could lead to competitive advantages for more sustainably produced food. As these products have higher marketing margins, retailers might benefit. In order to ensure an equitable distribution, mechanisms have to be developed how to allocate the monetary amounts additionally generated by paying 'true' prices. Farmers should benefit, if they bear part of the hidden costs. If additional costs accrue at the primary production level, additional monetary means from 'true' prices can be used to reduce subsidies at the farm level. Internalizing these external costs into market transactions could possibly lead to more efficient resource allocation decisions. If environmental costs emerge at a societal level and public action is required to mitigate environmental impacts, additional monetary means should be used to finance public action to reduce environmental impacts, e.g. financing climate mitigation measures. In this way, paying 'true' prices becomes effectively a climate tax. Furthermore, 'true' prices – i.e. higher prices – can be expected to reduce demand for products with high external costs, in this way also reducing production and thereby reducing the environmental impact. Information about external costs and/or a higher price that covers parts of these costs might also lead to a more conscious use of food among consumers and help reduce food waste.

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