

Three empirical studies on animal welfare policy and consumer search behaviour

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Sommario

Questa tesi si compone di tre capitoli. I primi due contribuiscono alla letteratura sulle politiche per il benessere animale negli allevamenti e sull'etichettatura relativa. Il terzo capitolo analizza il processo di ricerca online di elettrodomestici ad alto consumo energetico ed il ruolo dell'informazione sui consumi e sul costo dell'energia.

Il primo capitolo analizza due programmi governativi implementati in Svizzera per incentivare sistemi di allevamento più rispettosi del benessere animale. Si tratta di due programmi a partecipazione volontaria basati su incentivi ai produttori. Questi due programmi rientrano nel quadro più ampio di un pacchetto di interventi messo a punto dal governo svizzero con l'obiettivo di migliorare la sostenibilità del settore agricolo nazionale. In particolare, l'analisi si focalizza sui due programmi per il benessere animale chiamati BTS e RAUS. Gli allevatori svizzeri che decidono di aderire devono assicurare standard di benessere animale più elevati rispetto all'allevamento intensivo tradizionale. A questo fine ricevono un sussidio commisurato alla grandezza dell'allevamento e possono apporre l'etichetta di benessere animale garantita dal governo sui loro prodotti. Lo studio utilizza dati FAOSTAT per analizzare gli effetti di questa misura su produzione e consumo aggregato di carne di maiale, che è la tipologia di carne più consumata nel Paese. La metodologia del "controllo sintetico" viene impiegata per comparare le variabili di interesse in Svizzera con le variabili controfattuali di un gruppo di Paesi di controllo costruito per questo scopo. I risultati mostrano che l'adozione della politica riduce non solo la produzione, ma anche il consumo di carne di maiale in Svizzera. Questo suggerisce che la politica ha avuto un'ampia diffusione e causato un riassetto della produzione che, a sua volta, ha modificato il consumo, in quanto molto ancorato alla produzione nazionale a svantaggio della carne importata. Lo studio suggerisce che una politica per il benessere animale, in certe condizioni, non solo affronta il tema etico dell'allevamento, ma può anche avere effetti a catena su ambiente e salute attraverso la promozione di un minor consumo di carne in favore di maggiore qualità (in questo caso misurata in termini di benessere animale).

Il secondo capitolo si propone di analizzare la percezione e l'atteggiamento dei consumatori rispetto ad un'etichetta per il benessere animale innovativa basata su dati derivanti da allevamento di precisione¹. L'analisi utilizza un questionario distribuito online attraverso i canali dell'Università di Wageningen (Paesi Bassi) per raccogliere le opinioni dei partecipanti sull'etichettatura innovativa proposta. Il nuovo metodo di etichettatura non è ancora implementato e viene spiegato ai partecipanti all'interno del questionario. Da studi precedenti sappiamo che la scarsa trasparenza delle etichette tradizionali sul benessere animale contribuisce a creare una scarsa fiducia tra i consumatori e, di conseguenza, ad ostacolare l'acquisto di prodotti eticamente migliori. L'etichetta proposta potrebbe rappresentare una soluzione a

¹Termine originale: *precision livestock farming*.

questo problema consentendo ai consumatori di avere accesso a dati trasparenti su vari indicatori di benessere animale. L'atteggiamento dei consumatori rispetto a questo metodo di etichettatura è misurato attraverso numerose domande che raccolgono informazioni sulle loro opinioni, motivazioni, e valutazioni delle etichette tradizionali rispetto a quella proposta. I risultati suggeriscono che questo tipo di etichetta sarebbe soprattutto apprezzato da consumatori già interessati al tema ed informati, tuttavia ulteriori studi consentiranno di ottenere un'evidenza più conclusiva.

Il terzo capitolo utilizza dati di navigazione ed acquisto online per investigare il modo in cui i consumatori cercano ed acquistano elettrodomestici ad alto consumo di energia. Inoltre, la presenza di dati sperimentali sui frigoriferi consente di analizzare l'effetto che l'informazione sui costi relativi al consumo energetico ha sull'attività di ricerca e sull'acquisto. Da studi precedenti emerge che spesso i consumatori non riescono a valutare in termini di costo/risparmio le informazioni sulla classe energetica degli elettrodomestici. Rendere l'informazione sui consumi energetici e sui costi collegati più trasparente e saliente ha quindi un effetto sulla comprensione dei consumatori e può avere un impatto sulle scelte di acquisto. I risultati di questo studio mostrano che il processo di ricerca varia tra tipo di elettrodomestico e tra consumatori, soprattutto in relazione alla propensione all'acquisto. L'analisi sperimentale sui frigoriferi suggerisce che aggiungere all'informazione sull'efficienza energetica dettagli sul costo non ha un impatto sull'intensità di ricerca in generale, tuttavia l'effetto diventa molto significativo quando considerato in relazione alle preferenze iniziali dei consumatori in termini di classe energetica e prezzo.

Introduction

The use of natural resources to satisfy human consumption can pose serious environmental and ethical problems. The externalities produced by this activity affect the lives of people, the environment, and all other living beings with whom we share this planet and the ecosystems that we transform. Economists can contribute to the study of environmental and ethical issues by supporting policy-makers in transforming the political debate into effective policies.

This thesis intends to focus on two issues which fit in this discussion: (i) animal food consumption, intensive farming and the role of animal welfare policies; and (ii) consumer search activities of household appliances and the role of energy information disclosure.

Whether it is for food or the energy we use in our daily lives, how we satisfy our primary needs has an impact. Starting from the 50s, with the advancement of intensive farming, the issue of farm animal welfare has increasingly gained the attention of consumers and citizens, stimulating not only private initiatives but also policy changes. The increase in consumption

of animal products and the spread of intensive farming does not only poses controversial ethical questions but is seriously harming the environment and dramatically contributing to climate change. Similarly, the energy sector is a major contributor to pollution and climate change and measures to incentivise greener and more sustainable energy consumption have spread globally.

On the one hand, governmental action is most critical to tackle these problems. Governments can impose minimum standards to production, incentivise alternatives, and ensure enforcement. On the other hand, other market agents can play a key complementary role. Indeed, a subset of consumers are not only motivated by hedonic attributes or prices as they also care about the environmental and ethical consequences of their consumption choices.

For this reason, market tools, such as labelling, have spread across the globe with the aim to signal products' differences to consumers. Indeed, information is crucial to guide consumers' choice and overcome information asymmetries, which are especially dangerous when products' attributes are non-tangible.

The analysis of implemented policies is necessary to inform future interventions and the study of key market players is essential to better target such interventions. This thesis empirically analyses three case studies where ethical and environmental implications play a prominent part. The first chapter describes the Swiss approach towards the issue of farm animal welfare and analyses two programmes for farm animal welfare implemented by the Swiss government. The second chapter targets consumer perception and attitude towards a new type of animal welfare labelling based on precision livestock farming data. The third chapter analyses online consumer search of energy-intensive household appliances also in relation to energy information disclosure.

CHAPTER 1

Putting farm animal welfare on the table: insights from Switzerland

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Abstract

This study analyses the Swiss approach to farm animal welfare policy with focus on two incentive-based voluntary programmes, one for controlled-pasturage (RAUS scheme) and one for animal-friendly stabling (BTS scheme), both associated with government labels. The paper investigates the effect of such programmes on pigmeat production and estimated consumption by providing a comparison analysis between Switzerland and a synthetic control group. Findings show that pigmeat production and estimated consumption decrease, suggesting that the programmes contribute to this trend. Data show that the reduction in pigmeat produced domestically is not compensated by imports, supporting the hypothesis that consumers prefer Swiss pigmeat produced in compliance with higher animal welfare standards. This suggests that animal welfare policy does not only partially address the ethically controversial issue of intensive farming, but also offers policy options to decrease animal food consumption and to achieve broader goals in terms of environmental and health implications.

1.1 Introduction

The issue of farm animal welfare poses controversial ethical questions and has been gaining importance over the last decades as a result of animal agriculture intensification (Nocella et al., 2010). In 1965, a technical committee appointed by the British government to investigate the conditions of animals in intensive livestock farming compiled the Brambell report. This

document provided recommendations for the improvement of animal welfare in farming, which were then developed into the Five Freedoms¹ and have been constantly updated over time (Webster, 2001). Since then, public interest and consumer awareness have been rising. The investigations of animal protection groups and citizens' initiatives fuel the debate and advocate for changes in the policy arena.

Public participation is visible in many contexts worldwide. To name a few, in 2019 in the European Union a popular initiative called "End the Cage Age" was launched to ask a ban of all cages in factory farming across the EU; in 2008 in Switzerland a popular initiative has led to the revision of the Animal Protection Law (Law 455) towards the inclusion of more comprehensive and expanded requirements for animal welfare; in 2018 California voted for a phasing-out of cages for laying hens and crates for sows and veals, which took effect in 2020, and passed a legislation banning the in-state sale of animal products coming from cage farming, taking effect in 2022.

The citizens' demand for higher animal welfare in animal production is increasing, but we still have little evidence on the impact of animal welfare policies on the economy, and in particular on consumption and production of animal food products. These effects are likely to depend on the nature of the policies set in place. We might expect that higher animal welfare standards induce higher costs and therefore a decrease in the quantity of animal products available on the market. However, if incentives are in place the effect might be different. The magnitude and the direction of the effect are unclear *ex ante*, as it depends on the response of consumers and producers.

From a policy-oriented perspective, several studies target farm animal welfare and provide suggestions for its improvement. For example, Bennet (1997) suggests a combination of basic legislation and production subsidies, while subsidies to consumers are considered more suitable in Harvey and Hubbard (2013) because of their easier implementation. Vinnari and Tapio (2012) proposes two innovative policy options, one including taxation and one including production subsidies in which the government has a prominent role in the agrifood sector, with the aim to decrease animal food consumption and address the ethical and the environmental consequences of meat eating.

This study aims to evaluate two Swiss measures aimed at improving farm animal welfare, based on two farmer incentive schemes established by the government, in terms of impact on both production and domestic supply² of pigmeat. It must be noted that public participation and advocacy in Switzerland show that animal welfare is seen as a public good and an ethical goal to pursue (Phan-Huy and Fawaz, 2003). For this reason, the

¹(i) Freedom from hunger or thirst; (ii) Freedom from discomfort; (iii) Freedom from pain, injury or disease; (iv) Freedom to express normal behaviour; (v) Freedom from fear and distress.

²Food supply is considered a proxy for food consumption. More details are explained in section 3.

Swiss policy regime is an interesting case to study: on the one hand, the legislation reflects the social consensus and is very stringent. On the other hand, additional voluntary measures are promoted, such as the incentive schemes developed by the government, as well as several recognised private labelling schemes (Swiss Federal Office for Agriculture, 2016).

The role of consumers' trust in the supply chain is fundamental, as Nocella et al. (2010) highlights. Transparency on the controls carried out on farms is necessary to build the sector's credibility (Nocella et al., 2010). Lack of transparency corresponds to lack of trust and this explains why consumers' preferences for farm animal welfare often do not correspond to purchasing decisions, as it emerges in the case of Italy from the analysis by Mayfield et al. (2007). Trust is also influenced by the perceived truthfulness of the information provided on animal food products. Information provision is crucial, especially in relation to intangible food attributes such as farm animal welfare (Vanhonacker and Verbeke, 2014). Clear and certified labels help consumers to verify the claims on animal products (Bildtgaard, 2008) and foster consumers' trust in the production sector (Tonkin et al., 2015).

The government labels attached to the voluntary schemes under study certify that a specific animal product has been produced in compliance with higher animal welfare standards with respect to conventional farming and are guaranteed by the Swiss government. The Swiss Animal Protection Association is accredited by the Swiss government to carry out independent on-farm inspections for those participating in the voluntary schemes and is in charge of monitoring farm animal conditions also on behalf of non-governmental organisations for animal welfare labelling. Moreover, several animal welfare private labels adopted by the major Swiss retailers have been on the market since many decades now and have established a sound credibility among Swiss consumers (Phan-Huy and Fawaz, 2003).

Indeed, the concern of Swiss consumers on the issue of farm animal welfare is very high (Vogeler, 2017) as well as their trust in the production system (Phan-Huy and Fawaz, 2003). This is confirmed by newspaper articles in the national press, retailers' strategies, and data by the Swiss meat producer association Proviande, which show the consumers' strong preference for national products. Consumers demand animal friendly production and trust national products for their quality in general, and for their animal welfare component in particular (Phan-Huy and Fawaz, 2003). Abroad, the commitment of the Swiss consumers and retailers to respectively buy and offer higher animal welfare products has given origin to the so-called "animal welfare export" to other countries that wish to produce and sell their products in Switzerland, having a cascade effect also outside the national borders. For example, this is the case of selected Italian producers of prosciutto or buffalo mozzarella that must abide by the Swiss laws or higher animal welfare requirements in order to sell their products in Switzerland.

Pigmeat is the first type of meat consumed in Switzerland and is largely

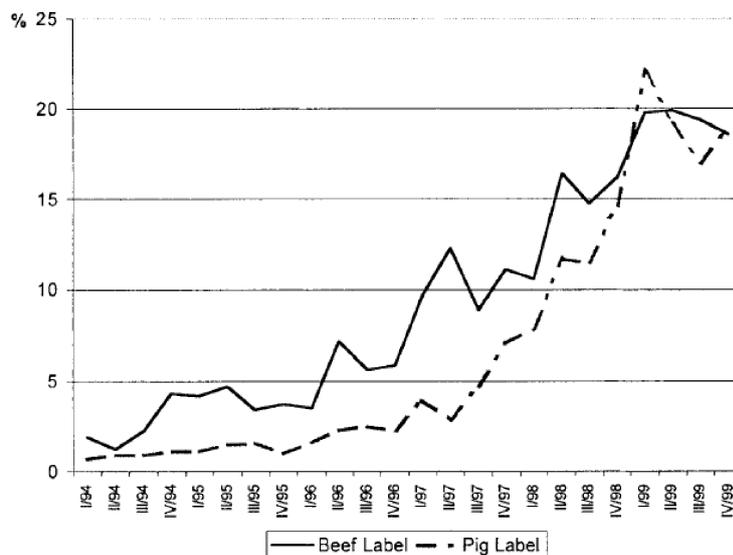


Figure 1.1: Share of labelled meat in total meat consumption in Swiss households (1994-1999). Source: Phan-Huy and Fawaz (2003)

produced domestically. This study investigates the effect of the voluntary schemes on pigmeat production and domestic supply (a proxy for aggregate consumption). The hypothesis is that, as a consequence of the schemes, a larger proportion of farming becomes less intensive as animals are given more housing space and more time outdoors (Phan-Huy and Fawaz, 2003). Such changes require investments and/or a decrease in the number of animals per farm, at least during the transition period in which the capacity of farms cannot change, which results in pigmeat production decline. Moreover, as a result of the high importance of domestic production in the Swiss market of pigmeat³, the change in production can drive a change in pigmeat consumption.

The empirical analysis is conducted using the synthetic control method (SCM) developed by Abadie and Gardeazabal (2003). This method is more suitable to this study than standard difference-in-difference methodology as it enables to create a synthetic counterfactual trend even in the absence of pre-existing common trends. Indeed, this methodology allows to create a control group which is data-driven, thereby solving the arbitrariness of the control selection. The results show that pigmeat production in the country decreased after the start of the policy, confirming the hypothesis that stricter requirements for farming imply lower numbers of animals per farm in the short-term. The same result applies to estimated pigmeat consumption.

³Around 90% of the total pigmeat consumed in the country is produced domestically. Source: Proviande.

These findings suggest that Swiss consumers' preferences for national animal products, also based on animal welfare considerations, are relevant to explain these trends.

1.2 Policy background

During the last decades, the European Union (EU) has devoted increasingly higher attention to the issue of farm animal welfare as shown by the increasing number of legislative and policy initiatives that have been put forward (Spoolder et al., 2011); (Mayfield et al., 2007). Most notably, the Council Directive 98/58/EC, which sets minimum standards in animal farming, is likely to be completely revised starting in 2022 to improve animal protection rules, also to respond to the Lisbon Treaty (2007), which amended the Treaty on the Functioning of the European Union (TFEU) and declares that animals are sentient beings (Article 13 of Title II). Despite institutional attention to animal welfare, the issue of low compliance in the farming industry is still severe in many member states (Vogeler, 2018). Previous studies find that the level of animal welfare in European farms varies considerably across the EU and that the southern countries are less inclined to implement EU legislation and enforce transparent and reliable controls than northern European countries (Vogeler, 2018).

Switzerland has shown a very high commitment to the cause of animal protection since more than a century, with subsequent legislative measures and policies adopted along the years. The first comprehensive Swiss legislation on animal protection was adopted in 1978 and entered into force in 1981 (Law 455). Switzerland has moved towards increasing levels of farm animal welfare ever since. The Law 455 has been updated in 2008 after a popular petition promoted by the Swiss citizens calling for new requirements, such as the inclusion of additional animal species and a better enforcement of the law by the cantonal administrations (Vogeler, 2017).

An evident example of the differences between the European Union and Switzerland is the use of cages. They are *de facto* banned in Switzerland since 1981, due to the stringent requirements imposed by the Animal Protection Law 455 (Phan-Huy and Fawaz, 2003). On the contrary, cage farming is still legal in the EU. However, the citizens' initiative "End the Cage Age" has been examined by the European Commission that in June 2021 announced its intention to phase out cages towards a complete ban in 2027, a very important decision for the protection of farm animals. Vogeler (2017) compares Switzerland with Austria and Germany, two European member states with farm animal welfare standards that exceed the European rules. All practices banned in the country are still largely diffused in the European Union, and Switzerland scores higher on all dimensions also with respect to Austria and Germany. A few examples of these practices, in the majority of

cases performed without anesthesia, include tail-docking of pigs, castration of pigs, teeth clipping of pigs, beak trimming of hens, and longer hours of live animal transport. Given these critical differences in farming, in the last decade the European Union has organised visits to Switzerland to learn best practices on pig rearing (European Commission, 2016).

In addition to the progressive legislative framework, the Swiss government has started two incentive-based schemes for improving animal welfare in farming during the 1990s. These schemes were part of a general reform of the Swiss agricultural policy of 1992 that fundamentally changed the type of support to farmers, establishing direct payments in substitution of market price support. The objectives of direct payments are both the support of farmers' income and the promotion of an environment-friendly agriculture (El Benni and Finger, 2011). The presence of price and market support had led in the 1970s and 1980s to an overproduction in agriculture, which paved the way to reform the agricultural policy towards multifunctional objectives. Indeed, the shift to direct payments contributed to increase the ecological practices in farming. It also induced an improvement in consumer welfare (Cretegnny, 2001). Figure 1.2 shows the structure of direct payments⁴. Subsidies cover a variety of agricultural practices with the aim to achieve several objectives. The schemes under study belong to the category of payments supporting animal production with higher animal welfare standards (fifth column).

⁴Source: <https://www.blw.admin.ch/blw/fr/home/instrumente/direktzahlungen.html>



Figure 1.2: Structure of direct payments. Source: Federal Office for Agriculture

The animal welfare schemes are based on animal units and subsidise higher animal welfare farming with the aim to achieve the following target: “every second farm animal lives in animal friendly conditions by 2005” (Phan-Huy and Fawaz, 2003, p.124). The voluntary schemes surpass the legal requirements “by various combinations of structural alterations and management practices” (Phan-Huy and Fawaz, 2003, p.125) in farming. Farmers participating in the schemes can use the government label that certifies the higher animal welfare standards of their products. The first voluntary scheme, the controlled pasturage programme (RAUS), started in 1993 with the aim to increase the time animals could spend outdoors. The second voluntary scheme, the animal-friendly stabling programme (BTS), started in 1996 and is intended to improve the stabling of animals with enriching materials, such as straw and litter, to enable more natural behaviour. Both schemes have been legally regulated in 1999 (Phan-Huy and Fawaz, 2003).

The two programmes are investigated in two veterinary studies. The analysis of the impact of RAUS and BTS schemes on veterinary costs for dairy cows by Odermatt et al. (2019) shows that participation in both schemes decreases the veterinary costs for farms. Additionally, the study by Cagienard et al. (2005) on pigs concludes that animal-friendly housing (BTS scheme) has a positive effect on the health and welfare of animals.

An interesting point is illustrated by Lusk and Norwood (2011) when the authors describe stocking density of animals and its relation with ani-

mal welfare, productivity, and profits. The authors argue that animal welfare is linked with animal productivity whereas it is not linked with their profitability. This passage is relevant to understand why the claim “happy animals are productive animals” is misleading. This is so because, although animal welfare and productivity go hand-in-hand, this is not true for profits. Producers would prefer higher profits rather than higher productivity, which results in a sacrifice of space (or general care) per animal and, in the end, of animal welfare.

Based on data provided by the meat producer association Proviande and the Swiss Farmers’ Union Agristat reported in Figure 1.3, the participation of Swiss farmers in the voluntary schemes is very high and increasing over time (Swiss Federal Office for Agriculture, 2016). This increasing trend suggests that the schemes are appreciated by farmers. We might assume that the benefit to participate in the schemes is not only represented by the subsidy but also by the opportunity to offer consumers higher animal welfare products with government label and obtain a reward for that. However, understanding the relevance of either elements for the schemes’ success is beyond the purpose of this study.

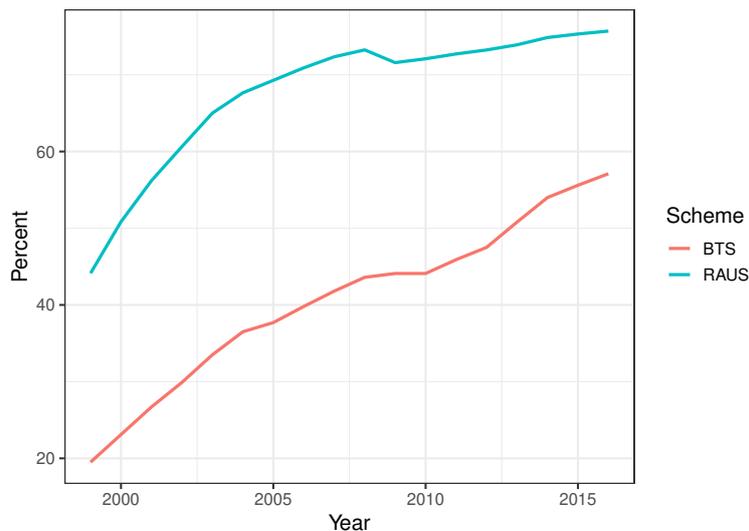


Figure 1.3: Scheme participation rates, author’s elaboration. Source: Proviande

1.3 Data and sample

The analysis is based on panel data on Switzerland and other 12 countries⁵ for the period 1970-2013. The RAUS and BTS voluntary schemes started

⁵ Austria; Denmark; Finland; France; Germany; Greece; Ireland; Italy; Netherlands; Norway; Sweden; and United Kingdom.

in 1993 and 1996 respectively. Therefore, the analysis covers 22 years in the pre-treatment period and 20 years in the post-treatment period.

The analysis aims to compare Switzerland with other western European countries, which are selected based on data availability and similarities in socio-economic characteristics. It is worth saying that all countries in the donor pool⁶ are subjected to the European regulations on animal welfare and each of them has their own national legislation and private initiatives. For example, Denmark, Sweden, and the UK have a long history of animal welfare legislation, while some other countries such as France and Italy show a very low level of compliance even with the European requirements (Vogeler, 2017). Some countries, such as Austria, Denmark, and Germany, have adopted more stringent measures in the years after the end of the period under study (Vogeler, 2017).

The dataset is constructed using aggregate data from the Food and Agriculture Organization database (FAOSTAT). Additional data to complement the empirical analysis are taken from the World Bank, the Swiss Federal Statistical Office, and the Swiss meat producer association Proviande.

The outcome variables are the following:

1. pigmeat production⁷ (in tonnes), from FAOSTAT Production database. It is derived from meat production as follows: production from slaughtered animals plus the meat equivalent of all animals exported alive, minus the meat equivalent of all animals imported alive. This variable already takes into account potential effects of the scheme on the import of live animals from other countries;
2. pigmeat domestic supply, or estimated pigmeat consumption (in tonnes and in kg/capita/year) from FAOSTAT Food Balance database. It represents the total amount of pigmeat available for human consumption during the year. At country level, it is calculated as the food remaining for human use after deduction of all non-food utilisations, such as exports, industrial use, animal feed, seed, wastage, and additions to stock. Wastage does not include consumption-level waste (i.e. retail, restaurant, and household waste).

The following explanatory variables are used to create the synthetic control group:

- logGDP per capita (World Bank);
- share of rural and urban population (FAOSTAT Population);
- GDP share of agriculture, forestry and fisheries (World Bank);

⁶Except Norway.

⁷Extended name in FAOSTAT is *indigenous pigmeat production*.

- import index for agricultural products (2004-2006 = 100) (FAOSTAT Trade);
- pigmeat import/export in tonnes (FAOSTAT Trade);
- producer prices of pigmeat live weight converted in USD (FAOSTAT Price);
- outcome variable averaged over five sub-periods before the adoption of the scheme in 1993, which adds an autoregressive component to the model.

Data on consumer prices are taken from the Swiss Federal Statistical Office. Data on tariffs are taken from the World Bank database.

1.4 Methodology

The study analyses the RAUS and BTS programmes for higher animal welfare in Switzerland by means of a comparison with a synthetic control group. The methodology follows that proposed in Abadie and Gardeazabal (2003) and Abadie et al. (2010) for comparative policy analysis.

To compare the actual outcome in Switzerland with the counterfactual outcome Y_{1t}^N , we need a model to estimate the outcome that we would observe in the treated country, Switzerland, in the absence of the treatment, the voluntary schemes. The counterfactual outcome corresponds to the outcome of the control group, which in the synthetic control method (SCM) analysis is constructed through an optimisation process. This optimisation minimises the mean square prediction error (MSPE) between the outcome variable in Switzerland and the outcome variable in the control group in the pre-treatment period conditional on the explanatory variables⁸, and determines optimal country weights. A formal explanation follows.

Consider $J + 1$ countries where country 1 is Switzerland and the other J countries are the control units in the “donor pool”. Define α_{it} as the effect of the intervention for country i at time t and D_{it} as the indicator that takes value 1 if the country is exposed to the intervention and 0 otherwise. Only country 1 is treated, therefore D_{it} will be equal to 1 only for country = 1 and $t > T_0$, where T_0 corresponds to the start of the treatment.

To assess the impact of the intervention, we aim to estimate $\alpha_{1t} = Y_{1t}^I - Y_{1t}^N$, where Y_{1t}^I is observed and is the real outcome of the treated country after the treatment. Therefore it is necessary to estimate the counterfactual Y_{1t}^N , which we build using the synthetic control methodology.

The model is specified as follows, where i is the indicator for each country, which takes value $i = 1, \dots, 1 + j$, and t is the total number of years considered in the study, which takes value $t = 1, \dots, T$:

⁸Following Abadie and Gardeazabal (2003).

$$Y_{it}^N = \delta_t + \Theta_t \mathbf{Z}_i + \lambda_t \boldsymbol{\mu}_i + \epsilon_{it} \quad (1.1)$$

where δ_t is a fixed time effect that does not vary across countries but varies over time, Θ_t is a vector of unknown parameters, and \mathbf{Z}_i is a vector of observed covariates. The unknown parameters Θ_t can vary over time. The country specific time effects are taken into account with the interaction term $(\lambda_t^* \boldsymbol{\mu}_i)$, where λ_t is a vector of unobserved common factors (unobservable confounders that may vary over time) and $\boldsymbol{\mu}_i$ is a vector of unknown country specific factor loadings. Finally, ϵ_{it} are the unobserved shocks.

Consider vector \mathbf{W} of weights which represents a potential synthetic control group, i.e. a weighted average of the J control countries, subject to the two constraints $w_j > 0$ and $w_2 + \dots + w_{J+1} = 1$. \mathbf{W}^* is chosen to minimise $(\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W})' \mathbf{V} (\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W})$, where \mathbf{X}_1 is a vector of pre-intervention characteristics for the treated unit, including both the covariates and the outcome variable, and \mathbf{X}_0 is the corresponding vector for the control units. Let \mathbf{V} be a diagonal matrix with non-negative elements. The values on the diagonal reflect the relative importance of different covariates \mathbf{X}_i and the values in \mathbf{V} are chosen to minimise the MSPE of the outcome variable between treated country and control countries in the pre-treatment period as in Abadie and Gardeazabal (2003)⁹. For each different vector \mathbf{W} we have the following expression:

$$\begin{aligned} \sum_{j=2}^{J+1} w_j Y_{jt} &= \delta_t + \Theta_t \sum_{j=2}^{J+1} w_j \mathbf{Z}_j + \\ &\lambda_t \sum_{j=2}^{J+1} w_j \boldsymbol{\mu}_j + \sum_{j=2}^{J+1} w_j \epsilon_{jt} \end{aligned} \quad (1.2)$$

Suppose that weights w_2^*, \dots, w_{J+1}^* are such that, approximately, the following is true:

$$\begin{aligned} \sum_{j=2}^{J+1} w_j^* Y_{j1} &= Y_{11} \\ \sum_{j=2}^{J+1} w_j^* Y_{j2} &= Y_{12} \\ &\vdots \\ \sum_{j=2}^{J+1} w_j^* Y_{jT_0} &= Y_{1T_0} \end{aligned} \quad (1.3)$$

⁹See Abadie et al. (2010) for a complete explanation of the methodology.

and

$$\sum_{j=2}^{J+1} w_j^* \mathbf{Z}_j = \mathbf{Z}_1 \quad (1.4)$$

where w_j^* is the optimal weight assigned to unit j .

In the model presented, the effects of confounding unobserved factors $\boldsymbol{\lambda}_t$ can vary with time without undermining results. The model does not eliminate the unobserved factor loadings $\boldsymbol{\mu}_i$, but a synthetic control group such that approximately:

$$\sum_{j=2}^{J+1} w_j^* \mathbf{Z}_j = \mathbf{Z}_1 \quad (1.5)$$

and

$$\sum_{j=2}^{J+1} w_j^* \boldsymbol{\mu}_j = \boldsymbol{\mu}_1 \quad (1.6)$$

gives an unbiased estimator of Y_{1t}^N .

The estimated treatment effect is $\hat{\alpha}_{1t} = Y_{1t}^I - \sum_{j=2}^{J+1} w_j^* Y_{jt}$ (Abadie et al., 2010).

1.4.1 SCM analysis

Following the model explained above¹⁰, the synthetic control group is created to best replicate the trend of pigmeat production in Switzerland in the pre-treatment period. The resulting control group, synthetic Switzerland, enables to observe a data-driven counterfactual scenario.

Table 1.1 reports the optimal vector \mathbf{W}^* of weights attributed to the control countries in the donor pool. The optimal weights result from the minimisation of the mean square prediction error (MSPE) of pigmeat production conditional on the regressors, over the pre-scheme period 1970-1992, between Switzerland and the control group.

¹⁰The empirical analysis uses the R package provided by Abadie et al. (2011).

Country number	Country name	Weight
1	Austria	0.002
2	Denmark	0.008
3	Finland	0.254
4	France	0.005
5	Germany	0.006
6	Greece	0.000
7	Ireland	0.000
8	Italy	0.000
9	Netherlands	0.009
10	Norway	0.221
11	Sweden	0.493
12	United Kingdom	0.001

Table 1.1: Optimal weights w_j^* for control countries in synthetic Switzerland (pre-schemes)

As Table 1.1 shows, Sweden, Finland, and Norway obtain the highest weights (out of which almost half goes to Sweden), whereas the other countries in the donor pool have marginal or zero weight. Country weights are based on the optimisation method explained before: the pre-scheme characteristics of the three countries with the highest weights are the most similar to Switzerland.

In the empirical analysis, the counterfactual outcome variable of interest to estimate, Y_{it}^N as specified in Equation 1, is pigmeat production in the absence of the schemes, which corresponds to pigmeat production in the synthetic control group where the three countries mentioned above have highest weight. The same applies to pigmeat supply (estimated consumption).

The vector of observed covariates Z_i includes the variables listed above. In particular, (i) GDP per capita, which is a relevant predictor of the magnitude of meat production and consumption in a country; (ii) shares of urban and rural population, as the population geographic distribution is likely to affect the relevance of the agriculture and livestock sector in an economy; (iii) agriculture value added as a share of GDP to take into account the importance of the agriculture sector in an economy; (iv) import unit/value index of agricultural products (2004-2006 = 100), as countries with similar characteristics in terms of agricultural imports have also a similar structure of the agriculture and livestock sector and a similar dependency on imports; (v) import/export of pigmeat (in tonnes) as they correlate negatively/positively with domestic production for a given level of consumption; and (vi) producer prices for meat live weight which are usually predictive of meat demand and supply. Additionally, the analysis includes the “special predictors” (see Abadie et al. (2010)), which are the lagged outcome variables for the two years before the start of the schemes and for four sub-periods between 1970 and 1990. This predictor is useful to take into account

the trend of the outcome variable in the pre-schemes period.

Table 1.2 reports the values of predictors in the period before the schemes. The SCM optimisation process allows to obtain more similar values to Switzerland's values (2nd column) than sample mean values (3rd column). Pigmeat quantities are expressed in tonnes.

Predictor	Treated	Synthetic	Sample mean
log GDP per capita (USD)	9.651	9.399	9.074
Rural population %	0.258	0.230	0.289
Urban population %	0.742	0.770	0.711
Agriculture import unit/value index	48.348	55.030	57.014
Agriculture value added (share of GDP, USD)	2.318	4.928	5.173
Pigmeat import	2022.261	8058.812	87244.250
Pigmeat export	584.478	27866.160	81523.221
Producer price of pigmeat live weight (USD/tonne)	4039.287	6198.363	2496.641
Pigmeat production in 1992	264093.000	265756.585	1038017.667
Pigmeat production in 1991	265392.000	259572.727	1039991.583
Pigmeat production average 1985-1990	279389.000	280357.260	1069448.43
Pigmeat production average 1980-1985	282394.333	281771.935	990248.500
Pigmeat production average 1975-1980	257247.000	256837.683	882649.792
Pigmeat production average 1970-1975	222911.167	224079.885	777581.917

Table 1.2: Pigmeat production predictor means (pre-schemes). Treated = Switzerland; Synthetic = synthetic control group

Figure 1.4 shows the trends in pigmeat production in Switzerland and in the three countries with highest weights from the donor pool.

While the Norwegian and Finnish trends are overall increasing, the Swedish pigmeat production shows a sharp decrease in 1990. Similarly to Switzerland, throughout the 1980s Sweden has started the discussion on the agricultural policy reform that was finalised in 1990 with the aim to abolish all internal market regulations (Rabinowicz, 2004). The reform was radical, but it was not fully implemented as in 1995 Sweden joined the European Union, thereby joining the Common Agricultural Policy as well. The drop in pigmeat production in the early 1990s is followed by a quick rise, due to the access to the EU common market, which happens in the years right after the introduction of the Swiss schemes under study. This shift might influence the result of our analysis, but the leave one out test that we perform later (see robustness checks) shows that our result is not driven by a single country. Moreover, when repeating the analysis without Sweden (see Figure 1.9 in Section 5.1), the trends remain unchanged. Therefore, we acknowledge that the Swedish policy changes might introduce some noise in the analysis, but we conclude that our approach remains valid.

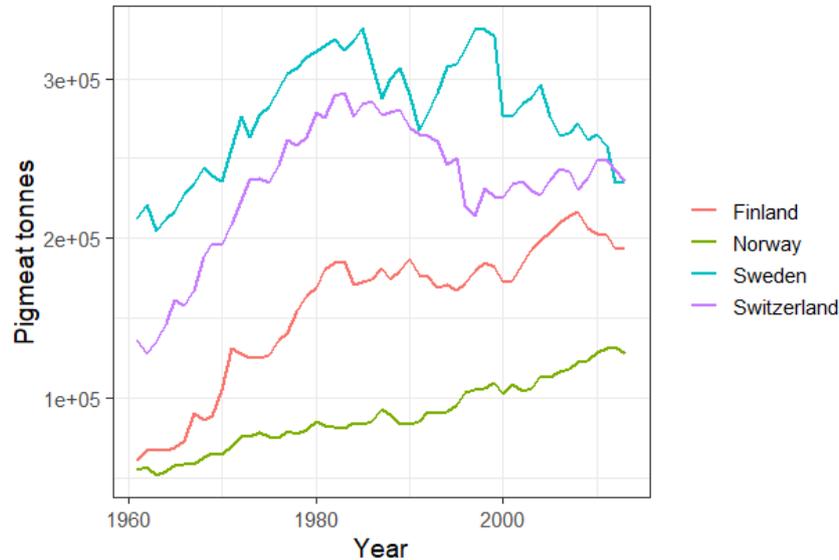


Figure 1.4: Pigmeat production (tonnes), author's elaboration. Source: FAOSTAT Production data

1.5 Results

The hypothesis of this study is that farm animal welfare incentive-based programmes contributed to the decrease in pigmeat production and supply (estimated consumption) occurred in the 1990s in Switzerland: higher animal welfare standards and the consequent changes in farming practices can explain the observed decline. The following analysis focuses on the effect of the RAUS and BTS schemes and shows the trends of pigmeat production and supply in the pre- and post-treatment periods under study (1970-1992 and 1993-2013).

The agricultural policy reform of 1992 completely changed the type of support to farmers, shifting from price and market support to direct payments. In this framework, the scheme for controlled pasturage (RAUS) started in 1993, while the scheme for animal-friendly stabling (BTS) started in 1996. In our analysis, we consider 1993 as threshold date, which corresponds to the start of the RAUS scheme. However, it is plausible that the anticipation effect was in place already at the beginning of the 1990s when the agricultural policy reform was being finalised. The post-treatment effect due to the first scheme, RAUS, and that due to the second scheme, BTS, are coexisting after 1996. We assume that also the years between 1993 and 1996 are characterised by a similar situation of coexisting effect: this is plausible as the government's intention to start the second scheme was already clear. As reported in Phan-Huy and Fawaz (2003) (p.124), the RAUS programme (1993) was "designed to promote not only regular pasturage, but

also animal-friendly stabling (...)”. However, the study explains that this target could not be achieved with the RAUS programme alone, especially as far as hens and pigs are concerned. Therefore, the government envisaged the introduction of a second programme (BTS) in 1996. For this reason, it is reasonable to assume that pig farmers in BTS scheme were already participating in the RAUS scheme (see A.3). We therefore consider the two schemes as a unique measure starting in 1993, which is set as time threshold in the analysis.

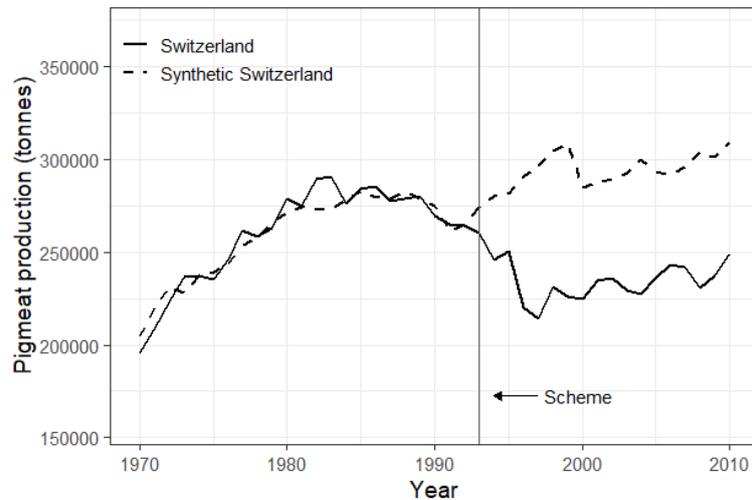


Figure 1.5: Pigmeat production (tonnes), Switzerland vs synthetic Switzerland

The first SCM analysis focuses on pigmeat production. As Figure 1.5 shows, the actual trend in production of pigmeat is lower than the counterfactual trend. The comparison between Switzerland’s and synthetic Switzerland’s trajectories shows that the Swiss pigmeat production decreases and settles at a lower level. The initial decrease can be interpreted as a consequence of the adaptation period in which production changes to comply with the new animal welfare requirements.

The next figure shows the gaps before and after the adoption of the scheme. Starting from the early 1990s, the pattern shows a clear decrease in pigmeat production in Switzerland with respect to the synthetic counterpart. It is worth noticing that the decline is sharp in the first years (approximately until 1998) after the start of the scheme. This is likely to mirror the adaptation time of production to the new requirements.

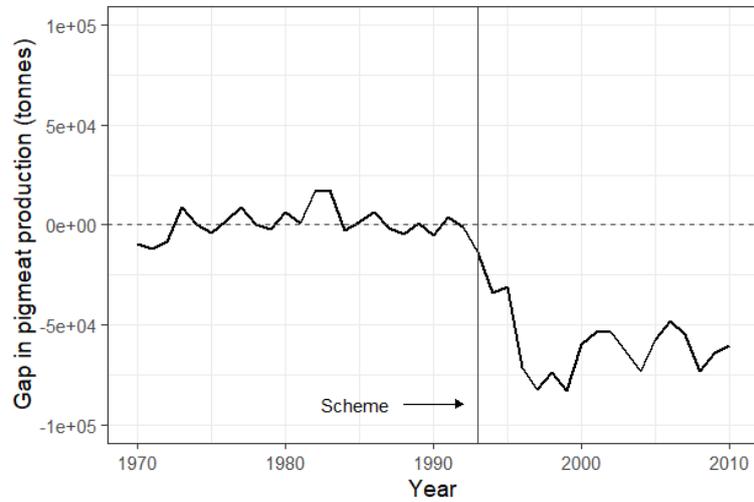


Figure 1.6: Gaps in pigmeat production (tonnes), Switzerland vs synthetic Switzerland

The second SCM analysis focuses on pigmeat supply, which is our proxy for estimated consumption. The analysis includes the same predictors of pigmeat production as pigmeat supply is strictly related to production and trade. The following figures show the trajectories of Switzerland and synthetic Switzerland when pigmeat supply is expressed in tonnes and in kg/capita/year.

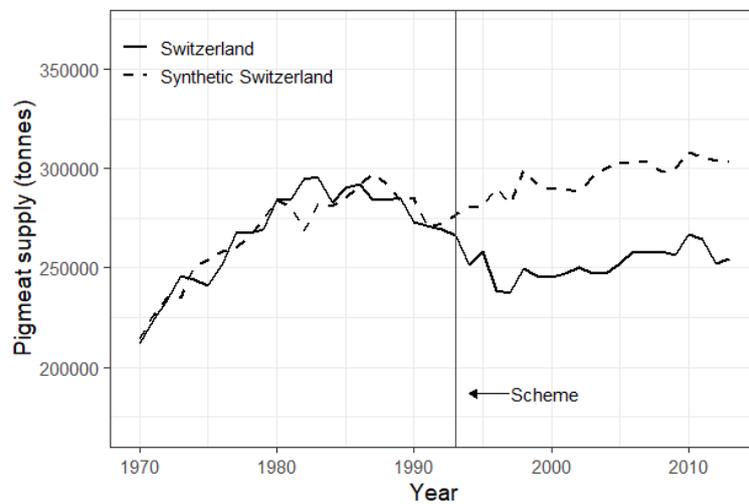


Figure 1.7: Pigmeat supply (tonnes), Switzerland vs synthetic Switzerland

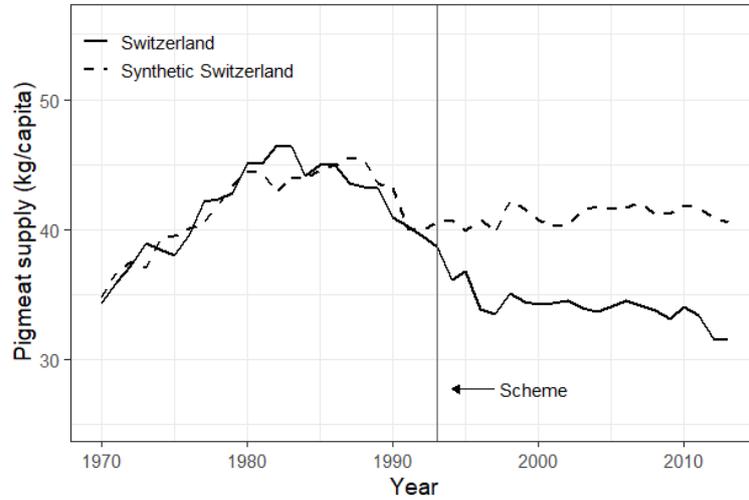


Figure 1.8: Pigmeat supply (kg/capita), Switzerland vs synthetic Switzerland

Figure 1.7 and Figure 1.8 show that pigmeat supply in Switzerland after the scheme is lower than the counterfactual with a sharp decline in correspondence to the first years after the start. This shows that, despite the observed decline in production, pigmeat import does not increase proportionally implying that overall pigmeat consumption decreases.

These results suggest that the adoption of the incentive-based voluntary programmes for higher animal welfare production systems have contributed to the decrease in pigmeat production and supply, due to the high uptake among farmers and the prominence of Swiss domestic production, that had a cascade effect on pigmeat consumption. Given that the schemes are part of a broader agricultural policy reform, we acknowledge that the observed trends might be influenced by other measures intended to increase the sustainability of the agricultural sector, via support to land conservation or biodiversity. However, given that the two schemes under study represent the main financial support to farmers for animal welfare improvements, we have reason to think that they explain the effect observed. To identify potential effects of other measures, additional data shall be identified and explored in further analysis.

1.5.1 Robustness checks

Following Abadie et al. (2010), the SCM analysis proceeds with robustness checks. The significance of results is evaluated through a series of placebo tests on pigmeat production. Robustness checks on pigmeat supply show similar results and are reported in the appendix.

Four tests are performed: first, we repeat the analysis by excluding Sweden from the donor pool.

The next figure shows that the trends does not change when Sweden is excluded. We can observe a moderate reduction in the gap between Switzerland and synthetic Switzerland, that however remains evident. In this case, the following weights are assigned to countries in the donor pool: 0.919 to Norway, 0.038 to Germany, and 0.03 to Denmark, while all others have zero weight.

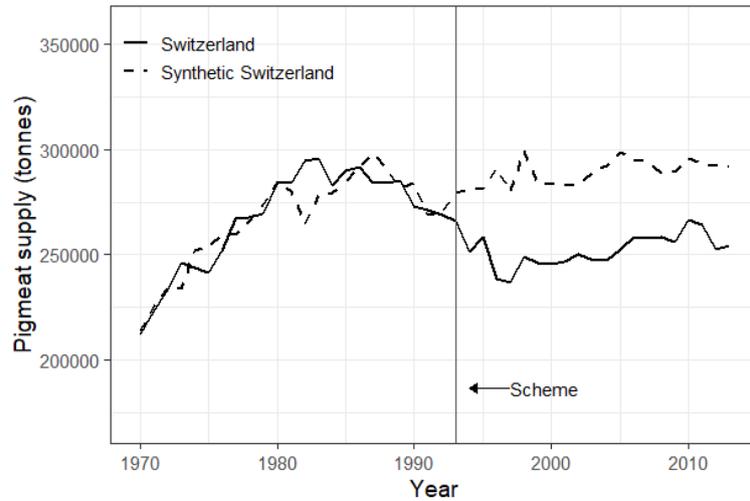


Figure 1.9: Pigmeat production (tonnes), Sweden excluded from donor pool. Source: FAOSTAT Production data

Second, the synthetic control method is applied by considering different starting dates of treatment, 1976 and 1985.

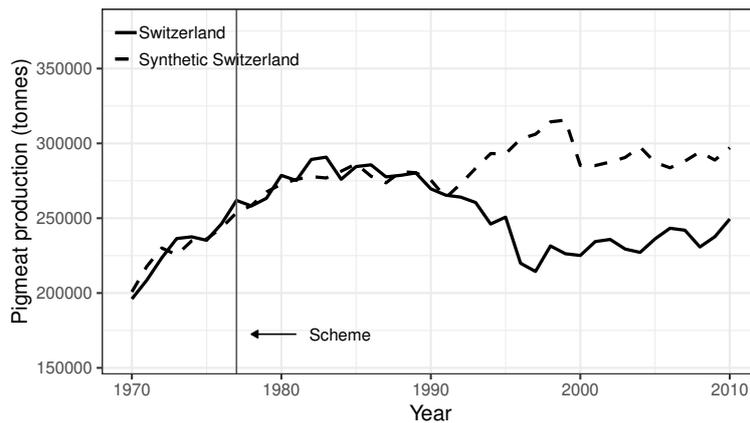


Figure 1.10: Pigmeat production (tonnes), Switzerland vs synthetic Switzerland, placebo test with year of treatment = 1976

The outcome variable should not be affected as no real treatment is in

place in these years. Moving the start date to either years (1976 and 1985) does not move the result in any significant way still depicting the departure of the real outcome from the synthetic one in correspondence to the true introduction of the scheme.

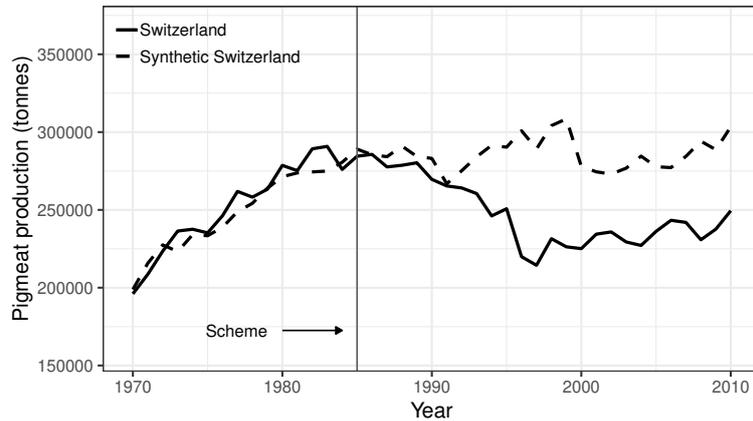


Figure 1.11: Pigmeat production (tonnes), Switzerland vs synthetic Switzerland, placebo test with year of treatment = 1985

As a third test, the analysis is repeated by leaving one country at a time out of the donor pool. Figure 1.12 shows that the new synthetic gap lines overall match the original gap line related to synthetic Switzerland (when the donor pool includes all control countries) especially in the first years after the treatment. This suggests that there is not a hidden country-specific effect driving the divergence between Switzerland and its synthetic counterpart.

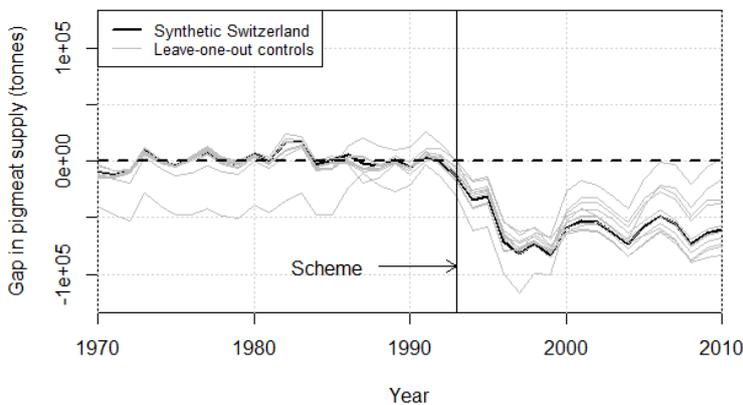


Figure 1.12: Gaps in pigmeat production (tonnes), leave-one-out test

In addition, the empirical analysis is performed to compare real and synthetic trends of domestic production of bovine and poultry meat. The results from the synthetic analysis show that poultry production is increasing over time but less than the counterfactual, namely at a lower pace with respect to the increase in synthetic Switzerland. This trend is in line with the exponential growth of consumer demand for this type of meat¹¹.

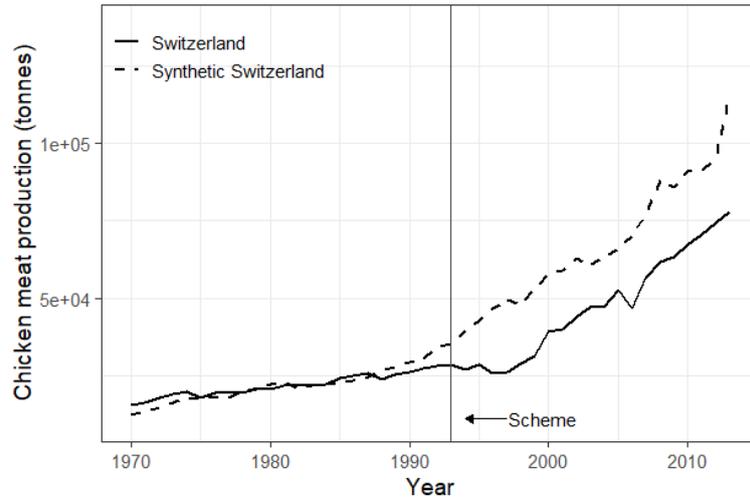


Figure 1.13: Chicken meat production (tonnes), Switzerland vs synthetic Switzerland

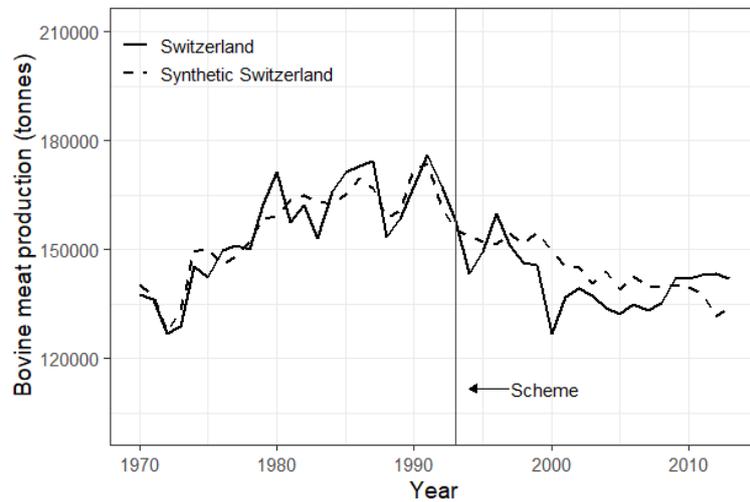


Figure 1.14: Bovine meat production (tonnes), Switzerland vs synthetic Switzerland

Bovine meat production oscillates over the period under study and the

¹¹See for example <https://ourworldindata.org/grapher/animals-slaughtered-for-meat>.

empirical analysis does not show a clear gap between the actual and counterfactual trends. A possible explanation is that time spent outdoors before the adoption of the scheme was higher for bovines than for pigs, implying lower adaptation costs for changing farm management.

We also acknowledge the fact that the several subsidy programmes for agriculture sustainability and land conservation implemented by the Swiss government might have affected differently the production of different types of meat.

1.6 Discussion and conclusion

This study contributes to the discussion on intensive farming and its ethical implications. In particular, we provide a comparative analysis of pigmeat production and domestic supply (estimated consumption) between Switzerland and a synthetic control group after the implementation of two voluntary incentive-based schemes in Switzerland (RAUS and BTS).

The results of this study show that the actual trends in quantities of pigmeat produced and supplied in the country are clearly lower than the counterfactual trends after the start of the schemes. Therefore, this analysis suggests that stricter animal welfare requirements and increasing participation of farmers in the schemes contribute to explain the decrease in pigmeat production and supply in Switzerland in the first years of the period under study and their stabilisation at a lower level.

These findings support the hypothesis that the voluntary schemes had an impact on farming practices. This hypothesis is corroborated by the high uptake of subsidies and suggests that the observed decline is driven by production. The fact that also pigmeat supply (or estimated consumption) has a similar trend suggests that consumption follows suit. This is consistent with the consumer preferences and positive willingness to pay for domestic meat reported in the study by Phan-Huy and Fawaz (2003), in which the origin of meat emerges as an important factor affecting purchase decisions also in relation to animal welfare considerations.

This analysis suggests that incentive schemes for animal welfare standards in animal agriculture affect production. Such effect on production can transfer onto consumption if the economy (or the sector) is relatively protected and does not depend heavily on import (for example via tariffs and/or quality standards), but also when the preference for domestic products is high. The presence of government labels associated to the schemes may represent an additional incentive for farmers to participate in the programmes and for consumers to trust the information provided, further increasing the success of the policy. Further research is needed to assess the role of labels in the farmers' appreciation of the policy.

It is also acknowledged that an extension of this analysis is necessary to

investigate possible substitution effects between different types of meat and separate the effect of the two animal welfare schemes analysed from other trends.

In conclusion, this study suggests that animal welfare policy can stimulate higher animal welfare production systems and ethical purchase in line with consumer preferences, if certain conditions are satisfied. In particular, farmers must be able to abide by higher animal welfare requirements, consumers must be informed and trust the production sector, and the government must ensure compliance and enforcement. By doing so, animal welfare policy does not only partially address the controversial issue of intensive farming, but also offers policy options to decrease animal food consumption and thereby foster positive effects on the environment and health.

The Swiss case is peculiar due to its protectionist trade policy. However, with due adaptation, a similar strategy could be discussed and promoted in other contexts alike, for example as part of the *Farm to fork* strategy included in the European Green Deal. The public and academic debates are lively and further research will help bring evidence to the table.

Appendix

A.0.1 Complementary figures

This section provides complementary figures: Figure A.1 reports data on livestock units (in %) in Switzerland.

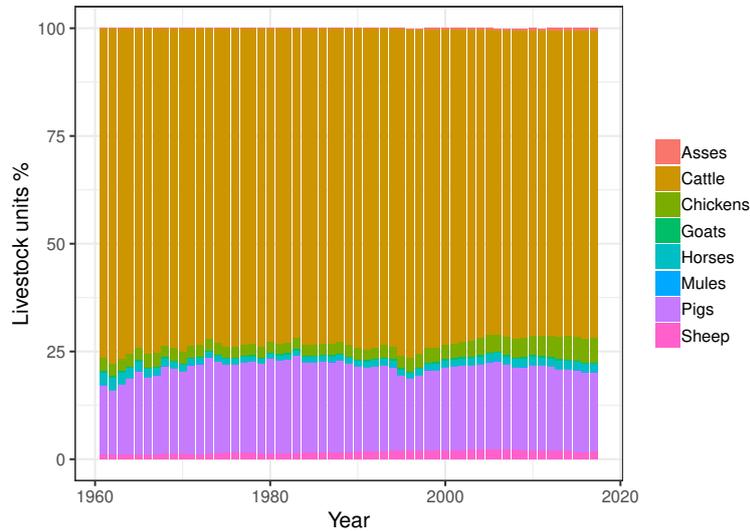


Figure A.1: Livestock units (%) in Switzerland, author's elaboration. Source: FAOSTAT Livestock Pattern data

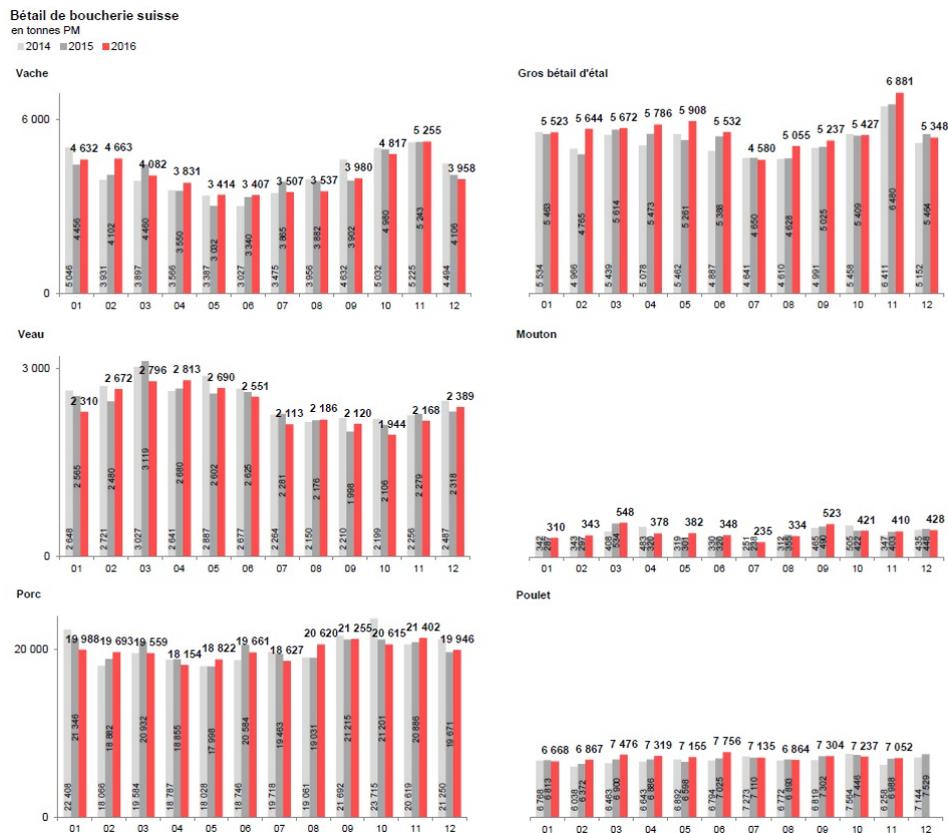


Figure A.2: Share of slaughtered livestock. Source: OFAG, *secteur Analyses du marché* (Swiss Federal Office for Agriculture, 2016)

Figure A.2 shows that bovines represent the biggest share of animals farmed in Switzerland, especially for dairy production, while pigs represent the biggest share of animals slaughtered for meat.

Figure A.3 shows that the pig sector participation in RAUS scheme is higher than the participation of the poultry sector, and participation in BTS scheme is higher than that of the bovine sector. This supports the hypothesis that the pig sector has been more affected by the schemes.

Figure A.4 shows per capita meat consumption by meat categories in Switzerland, where pigmeat shows the biggest share. The graph shows that consumption of all meat types has started to decrease around 1990, with the exception of poultry.

Programmes Bien-être des animaux de la Confédération

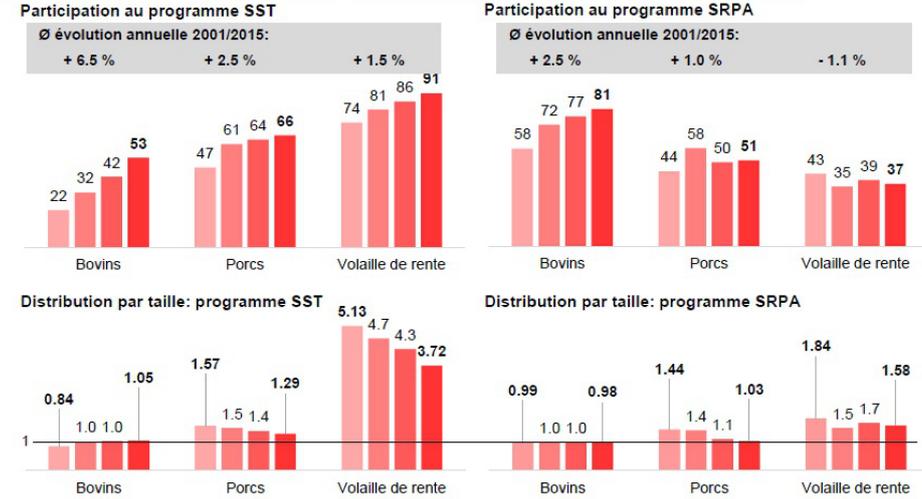
Evaluation de la participation des exploitations agricoles suisses aux programmes SST et SRPA

Participation en nombre d'unités de gros bétail (UGB) en %

Distribution par taille (participation UGB au programme / participation exploitations au programme) sans unité*

2001..2015 ■ 2001 ■ 2005 ■ 2010 ■ 2015

*Plus la valeur est élevée, plus la participation concerne une nombre important de grandes exploitations (à savoir des exploitations de grands troupeaux) par rapport à la participation de petites exploitations (1 = participation équilibrée de toutes les tailles d'exploitations au programme)



Source: OFAG, secteur Analyses du marché; SIPA

Figure A.3: Participation to the voluntary schemes by species. Source: OFAG, secteur Analyses du marché (Swiss Federal Office for Agriculture, 2016)

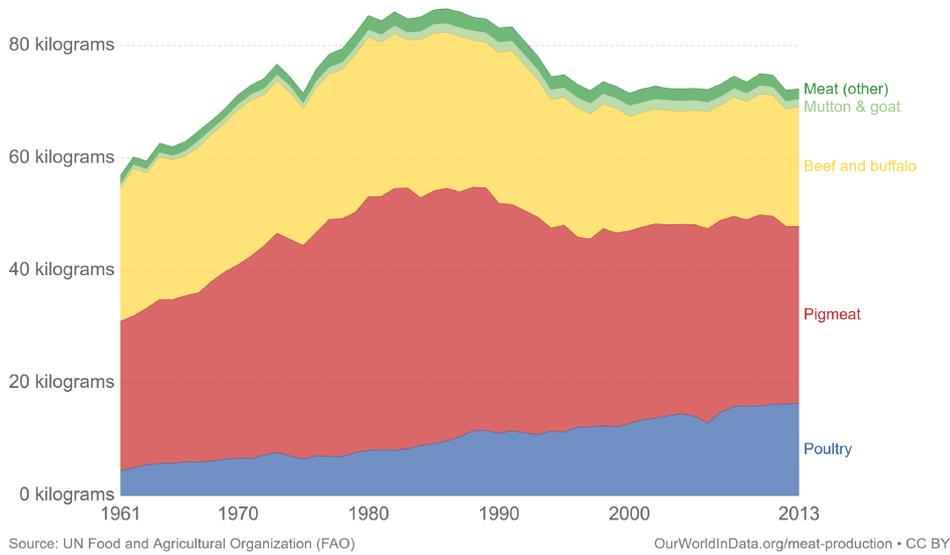


Figure A.4: Average per capita meat consumption broken down by specific meat types, measured in kilograms per person per year, Switzerland. Source: FAOSTAT Food Balance data, elaboration of Our World in Data (<https://ourworldindata.org/>)

Figure A.5 reports consumption prices for different pigmeat cuts in

Switzerland, based on data availability. It does not appear that any major increase in consumption prices occurred for any of the pigmeat category under scrutiny in correspondence with the year of the scheme adoption (1993) or the years after. Data on consumption prices are only available starting from 1990 and therefore could not be included in the SCM analysis.

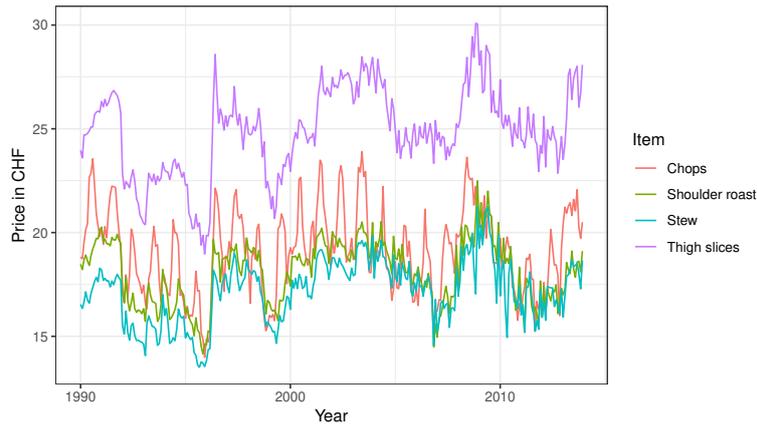


Figure A.5: Consumption prices for different cuts of pigmeat, CHF per kg or CHF per 100g for charcuterie, author’s elaboration. Source: Federal Office for Agriculture - OFAG, *secteur Analyses du marché*

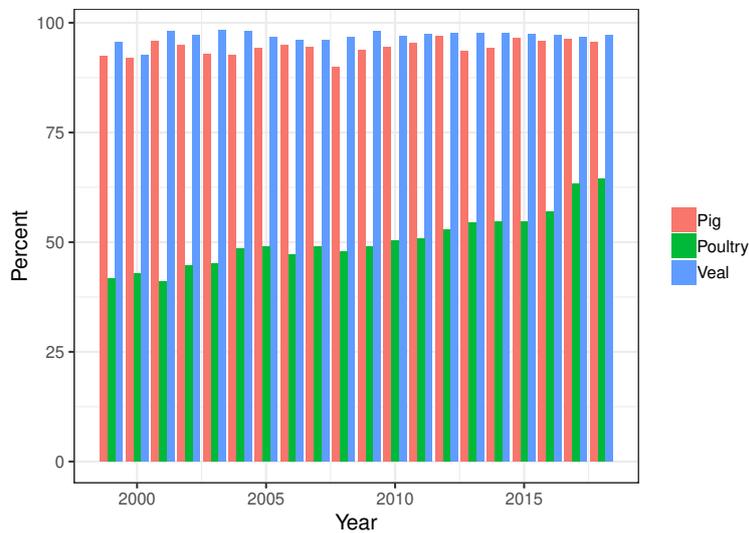


Figure A.6: Domestic production share in consumption, author’s elaboration. Source: Proviande

This study’s findings are supported by evidence on the domestic production share of consumption: the quantity of pigmeat consumed in Switzerland

is mostly produced within the country along the whole period of analysis, pre- and post-schemes. We compare pigmeat with veal, almost entirely produced domestically, and poultry, which is increasingly produced domestically, but still largely imported (Figure A.6). This explains why, in correspondence to a decrease in pigmeat production, consumption declines very similarly.

A.0.2 Robustness checks II

The next figures report robustness checks on pigmeat supply results, when pigmeat quantities are expressed in tonnes.

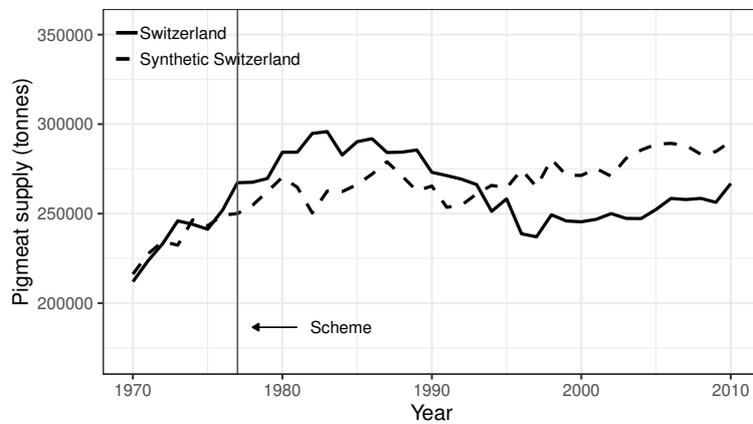


Figure A.7: Pigmeat supply (tonnes), Switzerland vs synthetic Switzerland, placebo test with year of treatment = 1976

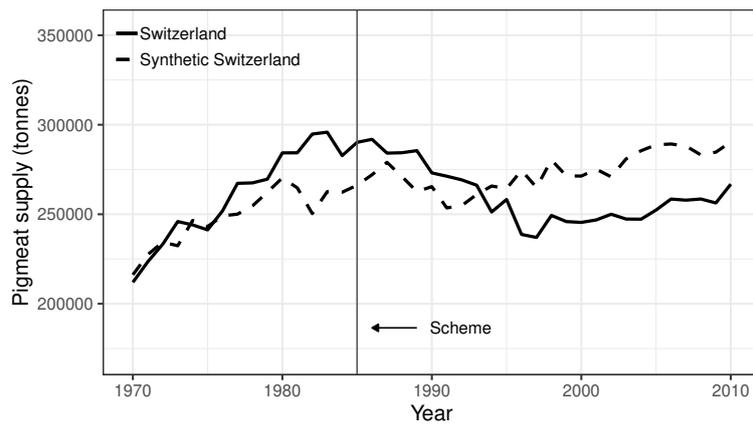


Figure A.8: Pigmeat supply (tonnes), Switzerland vs synthetic Switzerland, placebo test with year of treatment = 1985

When the analysis is conducted with 1976 as the threshold, results are

similar to those with correct time threshold. In both cases the trends of Switzerland and synthetic Switzerland diverge after the start of the scheme, although the gap before the start of the scheme is bigger than in the true scenario. A similar situation happens when 1985 is selected.

A possible explanation resides in the optimisation method discussed before. The minimisation of the MSPE of the outcome variable between Switzerland and synthetic Switzerland depends on the explanatory variables and the countries in the donor pool. In the case of pigmeat supply with true time threshold, the two countries with the highest weights are Norway and Sweden as in the case of pigmeat production, whereas, when the time threshold is shifted, Denmark gains more weight. However, Denmark had to be excluded from the donor pool due to a shock in the data in the after-treatment period that depends on a sudden fall in import and export data that cannot be accounted for. This is not a problem in all the other synthetic analyses, as Denmark has marginal weight. This can explain why the pre-treatment trends of Switzerland and synthetic Switzerland are less aligned in these tests.

Figure A.9 reports the leave-one-out test. It shows that the new synthetic gap lines overall match the original gap line related to synthetic Switzerland (when all countries are included in the donor pool). This suggests that there is not a hidden country-specific effect driving the diverging trend between Switzerland and its synthetic counterpart.

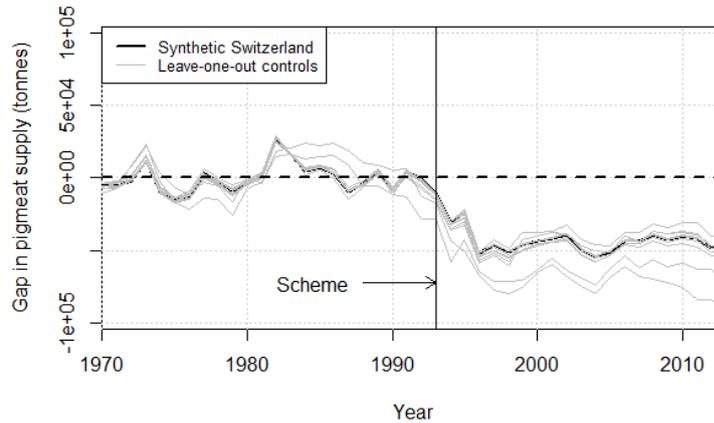


Figure A.9: Gaps in pigmeat supply (tonnes), leave-one-out test

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CHAPTER 2

Animal welfare labelling based on precision livestock farming: preliminary evidence on consumer attitude from The Netherlands

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Abstract

This study provides a preliminary analysis of consumer attitude towards a new type of farm animal welfare label. The analysis contributes to the literature by establishing a connection with the concept of precision livestock farming (PLF) and the potential solutions it offers to improve the transparency and trustworthiness of animal welfare claims. We use an online survey to collect preliminary evidence on consumer attitude towards traditional labels and the proposed innovative label. The label proposed is not yet implemented and it is described to participants in the survey, where they can partially experience the new label with the help of a technological tool. We use regression analysis and show that factual and perceived knowledge of animal farming and welfare standards have a positive influence on the attitude towards labels, similarly to the health and environmental motivation for buying animal foods produced with higher animal welfare standards. We find that overall the innovative label proposed does not positively affect the attitude of participants, nor their trust, although the evidence is not conclusive as the PLF label is not implemented yet. Further research is necessary to establish a clearer relationship between consumer characteristics and their appreciation of such a label.

2.1 Introduction

Over the past decades, consumers have become increasingly concerned about the level of animal welfare in the livestock sector as a result of animal production intensification (Nocella et al., 2010); (Blokhuis et al., 2013). The urge to increase animal welfare is predominantly driven by consumers, which, as such, can play a relevant role in improving ethical aspects in animal agriculture (Blokhuis et al., 2013).

Well-designed animal welfare labelling can address these concerns and at the same time improve animal welfare standards (Vanhonacker and Verbeke, 2014). Most importantly, a label must provide transparent and reliable information, which is crucial when choices are based on unverifiable attributes (Tonkin et al., 2015). However, the multiplicity of animal welfare labels on the market contributes to create confusion and generate distrust, which results in consumption choices not in line with preferences for higher animal welfare products.

Technology offers consumers new possibilities to make informed choices (Willems et al., 2017). Recent developments in smartphone shopping apps on one side, and in farming data collection on the other, could provide a solution by offering consumers the access to reliable animal welfare information. This would be possible thanks to the technology of precision livestock farming, which collects data through environmental sensors in the farm and non-invasive sensors on animals. A new type of label whose welfare claims are based on PLF data could represent a viable market tool to increase information transparency and thereby consumer trust. This could in turn result in purchase of higher animal welfare products. The idea behind this study originates from the ClearFarm project which is currently ongoing in the European Union and aims at improving animal welfare through precision livestock farming technology. In particular: “*ClearFarm proposes to use precision livestock farming technology and integration of animal-based data to enable improved animal welfare across the entire production chain. This will contribute to improved sustainable pig and dairy cattle production, the two livestock production systems with the highest shares of livestock products in Europe*¹.”

This study contributes to the literature with an empirical analysis of consumer attitude: we use an online survey to collect information on the attitude towards animal welfare labelling and on the effect of the technology-based label on such attitude. The sample includes 106 participants that are randomly assigned to the meat or dairy group, based on the type of animal product they will encounter in the survey. The survey includes questions on a generic traditional label², on the technology-based label, and on partici-

¹Source: <http://www.clearfarm.eu/the-project/>

²The traditional label presented in the survey is a generic label with usual characteristics of real animal welfare labels (e.g. an icon and a sentence on animal welfare that

pants' characteristics and preferences.

Results show that factual and perceived knowledge of animal farming standards, health and environmental concerns, as well as environmental ethics are good predictors of a positive attitude towards the two labels analysed. When we analyse the effect of the proposed technology-based label we find mixed results: overall, the new label does not improve the attitude of participants and does not increase trust. We acknowledge that the sample size, the possible self-selection bias of respondents, and the hypothetical nature of the analysis pose serious limitations to this study. Nonetheless, our preliminary results allow to highlight interesting questions. In particular, further research is necessary to investigate the effect of the technology-based label on consumer trust, ideally with the use of a label prototype in order to allow a more realistic evaluation.

2.2 Background

2.2.1 Animal welfare and labelling

Despite consumers show a general high concern for animal welfare, this does not translate into purchase decisions of animal foods produced with higher animal welfare standards (Grunert et al., 2014). This misalignment between attitude and behaviour is due to a number of factors, such as perception of scarce effectiveness of consumer choices, perception of scarce availability of ethical options, scarce transparency, and distrust (Vermeir and Verbeke, 2006); (Bildtgard, 2008).

The efficacy of animal welfare labelling depends on a variety of elements, among which consumer understanding of production standards and motivation (Keeling et al., 2012); (Grunert et al., 2014). However, consumer awareness of farming practices is generally low (Vecchio and Annunziata, 2012) and increasing the involvement of consumers through information campaigns could represent a solution to this problem (Vermeir and Verbeke, 2006). Another critical element is consumer trust (Tonkin et al., 2015); (Tonkin et al., 2016). Previous studies highlight the presence of consumer negative prejudices and distrust in relation to food labelling, mainly due to unmet expectations and lack of transparency (Bildtgard, 2008). This is particularly true for animal welfare labelling (Vanhonacker and Verbeke, 2014).

Mandatory labelling on production practices appear more trustworthy and suitable to decrease search cost and uncertainty in purchase decisions (Tonsor and Wolf, 2011); (Bureau and Valceschini, 2003). However, mandatory labelling on animal welfare is very difficult to implement (Vanhonacker and Verbeke, 2014) and the absence of monitoring and control activities in

increase the salience of the animal welfare attribute of the product displayed) created for the purpose of this study.

many contexts (Vogeler, 2018) would nonetheless hinder its enforcement and credibility.

Voluntary labels are more realistic in the current food market (Vanhonacker and Verbeke, 2014) and offer various examples of success³. In line with this trend, in the European Union the development of a new voluntary and harmonised label for farm animal welfare is currently under discussion⁴ (European Union, 2020). There are also examples of voluntary labels highly criticised as non-transparent and misleading, as in the case of the Italian *benessere animale*⁵ label, that does not provide information on production practices⁶ and requires very low animal welfare standards⁷.

Voluntary labelling can serve as a non-governmental regulatory device only if accuracy, transparency, and truthfulness of animal welfare information are guaranteed (Blokhuys et al., 2013). If successful, it can offer a quicker response to a variety of stakeholders' needs, such as citizens' and consumers' concerns, NGOs' requests, evolving scientific research, and marketing positioning strategies (Blokhuys et al., 2013), while providing inputs to the legislative and regulatory framework at the same time. Indeed, voluntary labels can push farm animal welfare above the legal standards up to the point in which there is market demand for it (Blokhuys et al., 2013); (Vanhonacker and Verbeke, 2014) and collectively contribute to enhance the animal welfare capacity of the market (Jones et al., 2017).

2.2.2 The proposed technology-based animal welfare label

Technology offers consumers new possibilities to make informed choices (Blokhuys et al., 2013). The present study proposes an innovative technology-based animal welfare label, which would make use of recent technological developments in smartphone shopping apps and farming data collection.

We propose a label that would use precision livestock farming technology to collect data on the welfare of farm animals. This is done through environmental sensors in the farm and non-invasive sensors on animals measuring biological substances that can provide objective evidence on welfare parameters of animal health, nutrition, comfort, emotional state, and natural behaviour. In this way, not only producers would be more informed about the welfare conditions of animals, but also consumers could benefit from a label's claim based on factual information (Bildtgaard, 2008). The possibility to create a transparent and accountable database with the support of precision livestock farming technology would lead to better monitoring and

³See for example the private label *Beter leven* in The Netherlands.

⁴See <https://www.consilium.europa.eu/en/press/press-releases/2020/12/15/council-supports-eu-wide-animal-welfare-label/#>.

⁵English: animal welfare.

⁶See for example <https://www.legambiente.it/comunicati-stampa/etichette-benessere-animale-ecco-perche-possono-essere-ingannevoli/> (in Italian).

⁷As an example, this label can be applied to animal products from intensive farming.

control of the animal welfare claims, and to higher transparency of information provided to consumers. This would be crucial to establish the label's credibility (Golan et al., 2001).

The technology-based label that we propose should also allow an interaction between consumers and the app. For example, a well designed chatbot⁸ could make a good tool to provide information to consumers in relation to the animal welfare standards of a particular product. The chatbot would provide detailed explanations on the production standards and the implications in terms of animal welfare, based on precision livestock farming data. The chatbot would also provide external links if the consumer is willing to further investigate the issue.

The scope of this innovative label is to enhance the capacity of consumers to find relevant information and make an informed choice when buying animal products⁹. Our hypothesis is that the use of PLF technology would provide consumers with transparent, verifiable, and clear information on animal welfare, with positive repercussions on the label efficacy. In addition, this possible increase in consumer involvement and trust could stimulate purchase of animal foods produced with higher animal welfare standards.

2.3 Data and sample

Data are collected through an online survey administered on Qualtrics. A total of 200 users were reached but due to incomplete answers the final sample includes 106 participants. The drop-out rate is very high, possibly due to the length of the survey. We declared at the beginning an estimated duration of about 20 minutes, which was probably slightly underrated, hence many participants might have stopped for the length of the survey. Additionally, we could not offer payments, but only a prize randomly assigned to one of the participants completing the survey. These two factors might explain the higher number of participants starting the survey and dropping out before completing it.

2.3.1 Survey structure

The survey is divided into three different parts¹⁰ and includes 92 questions. The majority of questions envisage answers based on 1-7 Likert scales, others

⁸A chatbot is a software programmed to interact with another agent - in this case consumers - to provide answers to specific questions and simulate a conversation.

⁹In relation to consumer-producer interaction and the use of chatbot we borrow basic concepts from the literature on shared decision making, which has been developed in medical research by exploring the potential of the patient-clinician interaction with the support of technology. See for example Elwyn et al. (2012) and Makoul and Clayman (2006).

¹⁰The complete survey is reported in the appendix.

are multiple choice questions, and few of them are open-ended questions asking participants to express their opinion and/or comment. The first part includes questions on a generic traditional label created *ad-hoc*, exploring the participants' evaluation of it; the second part introduces the innovative label and includes questions related to participants' attitude and perception of it; the last section includes general questions on socio-economic characteristics as well as personal habits and values of participants, such as their eating habits and ethical attitude towards the environment and animals (Haws et al., 2014); (Herzog et al., 2015).

In the socio-economic section, we include several questions on perceived and factual knowledge of animal welfare standards. Questions on perceived knowledge ask the participant to rank her/his knowledge of animal welfare standards on a self-perception basis, whereas questions on factual knowledge target specific aspects of animal farming to test the real knowledge of participants. Additionally, we ask participants if they usually consider labels when buying animal products and if they consider farm animal welfare as a relevant attribute during their purchase decisions.

In the technology-based label section, we provide an example of the functioning of the label to mimic in a simpler way the idea behind it. For this purpose, we enable participants to interact with a simplified chatbot to select one animal welfare requirement that they consider important when buying an animal product. Specifically, participants are shown several products with different levels of animal welfare. Then, they are asked to select one animal welfare parameter among those presented in the survey, such as space per animals, outdoor access, freedom to express natural behaviour, and transport hours. After their choice, participants are presented with a restricted group of products including only suitable options matching their choice.

The purpose is to show participants how the proposed new label would support consumers in obtaining animal welfare information. As we explain in the survey, the real version of the label would allow interaction with a chatbot to ask for animal welfare information, but it would be more complex. Indeed the label would allow access to information based on precision livestock farming data through a smartphone app. However, this feature could not be tested as the label is not implemented yet. We acknowledge that the absence of the final label implemented undermines the intelligibility of the label's potential and possibly its appreciation by consumers.

We randomly assigned participants to two different groups: (i) the meat group, for which all questions relate to meat; and (ii) the dairy group, for which the same questions target dairy products. We make this choice to uncover possible differences in the attitude of participants based on the product nature: the presence of vegetarians in our society shows that consumer attitude may vary when they consider animal products, such as meat, and animal-derived products, such as dairy, and consumer attitude towards the

label may vary alike. Therefore, we considered the effect of the label by food category as a policy relevant result.

We were not able to create an additional control group to test the overall effect of the PLF label (not based on food category) due to the sample size constraints depending on the tools we could use at the time of data collection.

2.3.2 Descriptive figures

The majority of participants are students and researchers at Wageningen University in the Netherlands, but the sample includes also participants reached through the university channel for external users.

Table 2.1 provides summary statistics of the sample. We observe that participants randomly assigned to the two groups are generally similar across the characteristics analysed.

		Frequency			Dutch figures
		Dairy group	Meat group	Total	
Education	PhD	0 (0.0%)	7 (14.9%)	7 (6.6%)	Tertiary education
	Master's degree	26 (44.1%)	19 (40.4%)	45 (42.5%)	40%
	Bachelor's degree	29 (49.2%)	15 (31.9%)	43 (41.5%)	Secondary education
	Secondary school	4 (6.8%)	6 (12.8%)	10 (9.4%)	39.2%
Employment	Employed	18 (30.5%)	20 (42.6%)	38 (35.8%)	77.5%
	Unemployed	11 (18.6%)	7 (14.9%)	18 (17.0%)	4.3%
	In education	30 (50.8%)	20 (42.6%)	50 (47.2%)	-
Monthly income	Below 1300 euro	20 (33.9%)	14 (29.8%)	34 (32.1%)	Average income 3895 euro
	1300-2600 euro	10 (16.9%)	6 (12.8%)	16 (15.1%)	
	2601-3600 euro	8 (13.6%)	8 (17.0%)	16 (15.1%)	
	3601-5000 euro	4 (6.8%)	7 (14.9%)	11 (10.4%)	
	Above 5000 euro	8 (13.6%)	8 (17.0%)	16 (15.1%)	
Gender	Female	39 (66.1%)	26 (55.3%)	65 (61.3%)	51%
	Male	19 (32.2%)	21 (44.7%)	40 (37.7%)	49%
	Other	1 (1.7%)	0 (0.0%)	1 (0.9%)	-
		Mean (Standard Deviation)			
		Dairy group	Meat group	Total	Dutch average
Age		34 (17.8)	35 (17.2)	34 (17.4)	42.2
Household size		3 (1.9)	2.5 (1.5)	2.8 (1.8)	2.15

Table 2.1: Sample characteristics.
Source of Dutch figures: OECD Data and CBS Statistics Netherlands.

		Frequency		
		Meat group	Dairy group	Total
Eating ethics	Omnivore	22 (37.3%)	20 (42.6%)	42 (39.6%)
	Flexitarian	27 (45.8%)	16 (34.0%)	43 (40.6%)
	Vegetarian	6 (10.2%)	7 (14.9%)	13 (12.3%)
	Vegan	0 (0.0%)	1 (2.1%)	1 (0.9%)
	Other	4 (6.8%)	3 (6.4%)	7 (6.6%)
Animal welfare consideration	Always	13 (22.0%)	9 (19.1%)	22 (20.8%)
	Sometimes	28 (47.5%)	26 (55.3%)	54 (50.9%)
	Rarely	16 (27.1%)	10 (21.3%)	26 (24.5%)
	Never	2 (3.4%)	2 (4.3%)	4 (3.8%)

Table 2.2: Participants' habits

Table 2.2 reports eating habits and shows that the majority of participants categorise themselves either as omnivores or flexitarians. This distribution ensures that the sample captures the preferences of consumers who actually consume animal products in their diet. Moreover, as de Bakker and Dagevos (2012) argues, the group of flexitarians is going to be key in pursuing a more ethical meat consumption¹¹ representing also an interesting group of consumers to analyse in our study.

Table 2.2 shows that the majority of participants consider animal welfare *sometimes* when buying animal products, and we might expect that this category of consumers would be the most responsive to the animal welfare information changes introduced by the proposed new label.

	Average score (standard deviation)					
	Meat group		Dairy group		Total	
	Traditional	New	Traditional	New	Traditional	New
Confidence	5.3 (0.9)	5.5 (0.9)	5.4 (0.99)	5.6 (0.9)	5.3 (0.9)	5.5 (0.9)
Trust	4.6 (1)	4.7 (1.1)	4.9 (1)	4.9 (1)	4.7 (1)	4.8 (1)

Table 2.3: Comparison of attitude towards traditional (T) and new (N) label.
Score range 1-7, 1 = very low, 7 = very high

Table 2.3 provides participants' levels of trust and confidence in finding information for both labels. From these figures we can see that the values

¹¹The authors refer to more sustainable meat consumption via reduction in quantities; higher animal welfare represents not only a goal per se, but also an instrument to promote a reduction in meat (and other animal food) consumption in favour of higher quality.

for the new label are always slightly higher than those for the traditional label, but these differences are very small.

In the graphs below, we report the distribution of perceived and factual knowledge among participants. Participants show overall a high understanding of animal welfare practices, and this might depend on the composition of the sample.

Participants are asked to rate their understanding of animal welfare standards and Figure 2.1 shows the distribution of participants' perceived knowledge based on the three questions below:

1. How familiar are you with animal welfare standards?
2. How much do you know about animal welfare standards?
3. How would you rate your knowledge about animal welfare standards relative to the rest of the population?

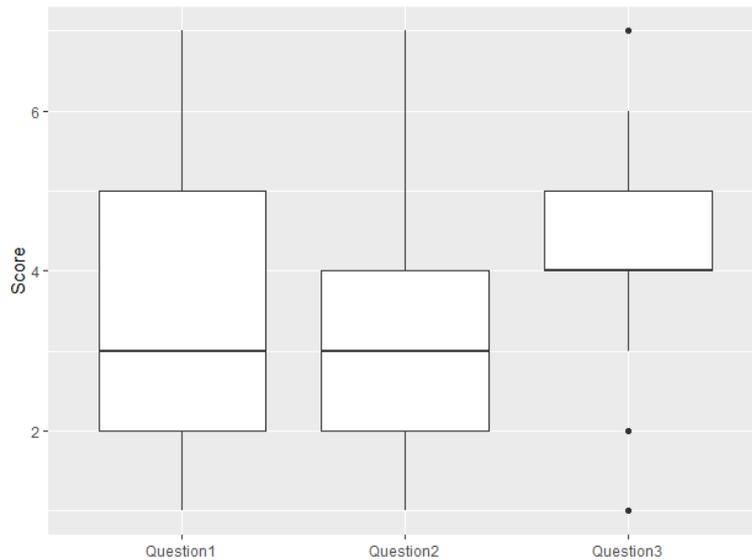


Figure 2.1: Perceived knowledge distribution. (1 minimum rate, 7 maximum rate)

Figure 2.2 shows the distribution of factual knowledge based on participants' agreement with the following statements:

1. In conventional farming animals can stay outdoors.
2. Free range farming allows animals to express more natural behaviour.

3. In conventional farming newly born animals grow up with their mother.
4. Free range farming allows animals to have more and enriched space.

Overall, participants' answers to factual questions show that the general understanding of animal farming and welfare implications is fairly high.

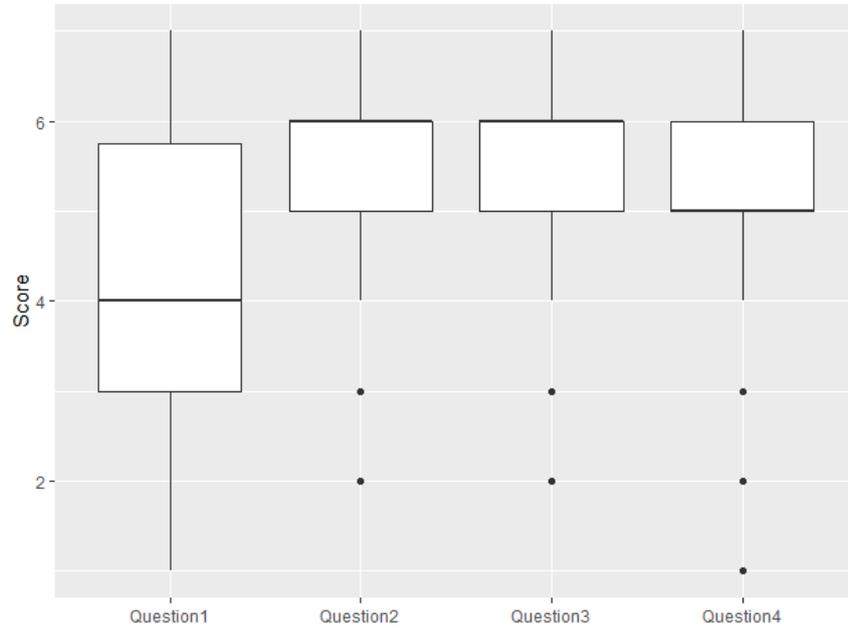


Figure 2.2: Factual knowledge distribution. (1 minimum score, 7 maximum score)

Figures 2.1 and 2.2 show that, on average, participants perception of knowledge is lower than their factual knowledge. This could be due to the fact that the factual questions in the survey are relatively simple and even non-expert consumers can answer correctly.

Figure 2.3 shows the correlation between selected participants' characteristics and variables of interest.

Correlation coefficients in white are non-significant, while correlation coefficients in red/green are negative/positive and significant¹². The table shows that factual knowledge is positively and significantly correlated with perceived knowledge, but only factual knowledge is significantly and positively correlated with trust and confidence in the two labels (however not with confidence in the traditional label). The table also shows that trust and confidence are positively and significantly correlated with one another for both labels. The table also shows interesting correlation coefficients between

¹²Significance level is 0.05.

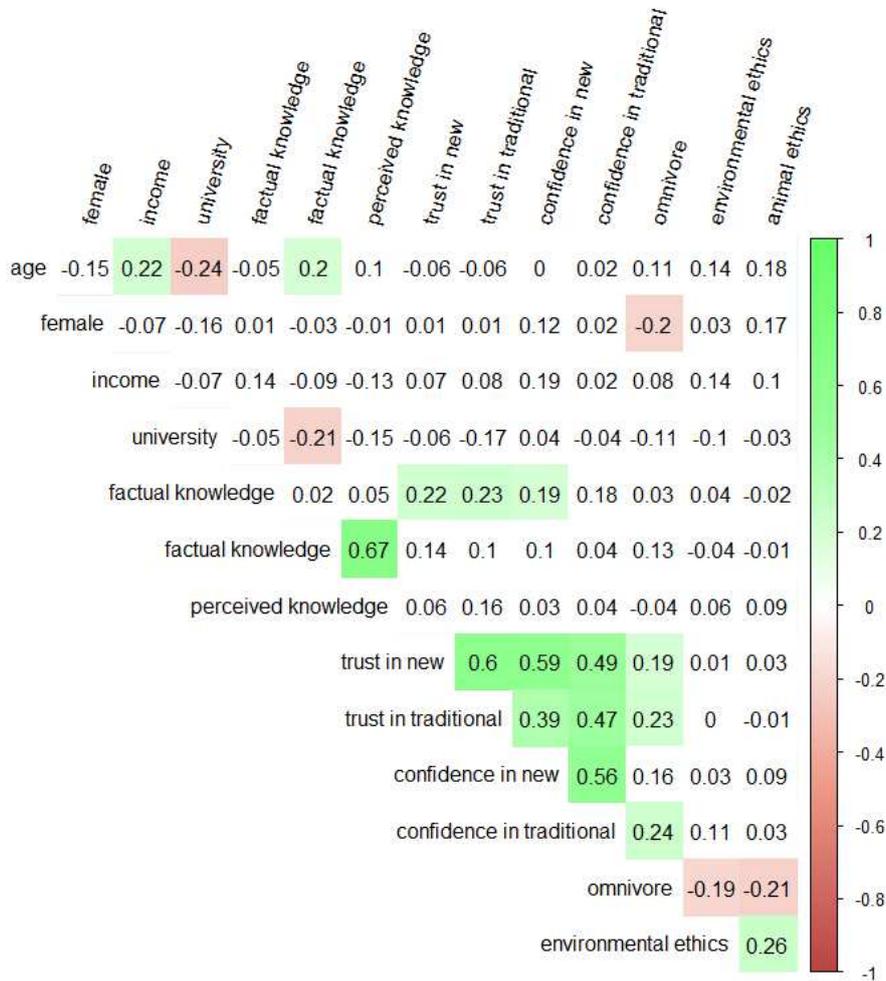


Figure 2.3: Correlation matrix. 0.05 significance level

being omnivore and environmental and animal ethics, which are significant and negative. The correlation coefficient between being female and being omnivore shows that in our sample gender (female) is a positive predictor of eating habits different from the omnivore diet, in line with previous research’s findings on the higher proportion of women following a vegetarian or vegan diet (Mensink et al., 2016).

2.4 Empirical analysis

The analysis aims to investigate the attitude of participants towards the new PLF technology-based label. Firstly, we aim to establish correlational relationships between participants’ characteristics and their attitude towards

the labels with no distinction between the two types of label. Secondly, we exploit the within-subject analysis in which each participant evaluates the two labels in two different parts of the survey and analyse the effect of the proposed technology-based label on participants’ attitude.

We consider the following specification:

$$y_i = \beta_{1i} + \beta_2 knowledge_i + \beta_3 ethics_i + \beta_4 eatinghabits_i + \beta_5 meatgroup + \beta_6 technologylabel + \beta_7 X_i + \epsilon_i$$

where y_i is one of the following outcomes of interest:

1. trust;
2. confidence to find relevant information;
3. usefulness;
4. intention to use.

The variable *knowledge* is a vector including perceived and factual knowledge: we include a variable based on the question “how much do you know about animal welfare standards?” as a proxy for participants’ perceived knowledge, while we include a factual knowledge variable based on the level of agreement with the statement “free range farming and conventional farming are not particularly different”. Both knowledge variables are binary with value 1 if the answer is > 4 on the Likert scale, and 0 otherwise.

The variable *ethics* is a vector including environmental and animal ethics, the variable *eatinghabits* tags participants who are omnivore and flexitarian as they are more representative of the general population¹³. Participants are asked why they pay attention to labels when buying animal products: we include two *motivation* binary variables for those who declare that they do so for (i) health and/or for the (ii) environment. We acknowledge that there is a risk for such variables to be endogenous, hence we refer to the results observed in terms of correlational effects. We also include two binary variables for the meat group and for the new technology-based label proposed. Lastly, we include control regressors in the matrix \mathbf{X} , which contains participants’ socio-economic and demographic characteristics, such as age, gender, education (taking value 1 for those with university degree), and income.

Given that the dependent variables take value 1 to 7, we perform ordered logistic regressions. Results are reported in Table 2.4.

¹³For detailed statistics see for example <https://www.vegansociety.com/news/media/statistics>.

	<i>Dependent variables:</i>			
	Trust	Usefulness	Confidence	Use intention
Factual knowledge	0.580** (0.295)	1.409*** (0.309)	1.145*** (0.313)	0.916*** (0.341)
Perceived knowledge	0.255*** (0.095)	0.214** (0.099)	0.236** (0.096)	0.281*** (0.107)
Health motivation	0.124 (0.331)	0.749** (0.352)	0.349 (0.341)	0.918** (0.389)
Environment motivation	1.316*** (0.311)	1.033*** (0.315)	1.068*** (0.315)	0.712** (0.351)
Eating habits	0.648* (0.361)	-0.275 (0.385)	0.765** (0.387)	0.383 (0.421)
Environmental ethics	-0.051 (0.422)	1.093*** (0.413)	0.694 (0.422)	1.624*** (0.533)
Animal ethics	-0.328 (0.347)	-0.158 (0.353)	-0.187 (0.347)	1.224*** (0.397)
Meat group	0.515* (0.269)	0.531* (0.283)	0.252 (0.284)	0.277 (0.371)
Tech label	-0.014 (0.252)	-0.132 (0.261)	0.788*** (0.266)	-1.118*** (0.393)
Age	-0.014* (0.008)	-0.010 (0.008)	-0.013 (0.008)	0.002 (0.009)
Female	0.174 (0.289)	0.369 (0.292)	0.461 (0.297)	0.368 (0.331)
University	-0.469 (0.293)	0.660** (0.296)	0.054 (0.291)	0.835** (0.335)
Income	0.037 (0.078)	-0.017 (0.081)	0.009 (0.078)	-0.084 (0.086)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Table 2.4: Participant attitude

Results show that factual knowledge, perceived knowledge, and environmental motivation have a positive and significant effect on all attitude dimensions. This suggests that participants which are, or feel, more knowledgeable on animal welfare standards are more likely to trust and use animal welfare labels, value more positively the labels' usefulness, and are more confident to find relevant information on the labels. The same applies to participants who value animal welfare labelling mainly because of their environmental concerns.

Other predictors have mixed effects: health motivation has a significant and positive effect only on two attitude dimensions, usefulness and use in-

tention, similarly to the environmental ethics, while animal ethics has a significant and positive effect on use intention. The effect of being assigned to the meat group is slightly significant (10%) in two cases only, suggesting that in our sample the type of animal product considered does not have a major impact on the participants' attitude towards the labels. The effect of the proposed innovative label on the four dimensions of attitude is mixed and non-significant on trust. It becomes significant and positive on confidence, while it is significant and negative on the intention to use the label. These results are mixed and show that the the new label as described to participants in this study is not overall perceived better than traditional labels.

We acknowledge that some predictors, such as eating habits, perceived and factual knowledge, can be endogenous. We therefore only assess the correlational relation between such variables and the outcome of interest to map the attitude of consumers towards the new type of label proposed.

Based on the results above, we investigate the effect of the technology-based label on participants' attitude by interacting it with selected predictors. We include interaction terms with the variables that showed higher explanatory power in the previous analysis.

	<i>Dependent variables:</i>			
	Trust	Usefulness	Confidence	Use intention
Factual knowledge	0.421 (0.386)	0.837** (0.395)	0.837** (0.417)	0.664* (0.384)
Perceived knowledge	0.272** (0.128)	0.453*** (0.133)	0.323** (0.132)	0.347*** (0.129)
Health motivation	0.154 (0.331)	0.814** (0.354)	0.355 (0.341)	0.962** (0.392)
Environment motivation	1.315*** (0.392)	1.172*** (0.418)	0.971** (0.405)	0.718* (0.397)
Eating habits	0.519 (0.348)	-0.424 (0.381)	0.617* (0.373)	0.255 (0.415)
Environmental ethics	0.164 (0.582)	1.243** (0.538)	0.926* (0.561)	1.208** (0.565)
Animal ethics	-0.346 (0.339)	-0.151 (0.344)	-0.111 (0.341)	1.284*** (0.397)
Tech label	0.100 (0.988)	1.108 (0.986)	1.318 (1.047)	-2.406 (1.507)
Tech label*factual knowledge	0.317 (0.543)	1.044* (0.548)	0.630 (0.569)	0.488 (0.685)
Tech label*perceived knowledge	-0.071 (0.177)	-0.534*** (0.185)	-0.195 (0.181)	-0.257 (0.218)
Tech label*environment motivation	0.141 (0.514)	-0.121 (0.537)	0.238 (0.537)	-0.386 (0.703)
Tech label*environmental ethics	-0.172 (0.746)	-0.102 (0.753)	-0.477 (0.766)	2.292* (1.359)

* p < 0.10, ** p<0.05, *** p<0.01. Standard errors in parentheses.

Table 2.5: Participant attitude towards the new label

Table 2.5 shows that the technology-based label variable has no significant effect on participants' attitude and even when interacted its overall effect remains negligible. Contrary to the expectations, when interacted with perceived knowledge it shows a negative and significant effect on the usefulness of the label. A possible explanation is that participants who feel more knowledgeable on the matter think that a label as such would not improve their ability to discern animal welfare information and therefore value its usefulness poorly.

We are also interested in the analysis of participants' intention to shift their consumption choices towards higher animal welfare products in presence of the technology-based label because of higher guarantee on the veracity of animal welfare claims. The outcome is a categorical variable taking

value 1 to 7. Results are reported in Table 2.6.

	<i>Dependent variable:</i>
	Shift towards higher animal welfare products
Factual knowledge	1.850** (0.650)
Perceived knowledge	0.110 (0.194)
Health motivation	2.740** (0.921)
Environment motivation	0.188 (0.599)
Eating habits	-0.200 (0.786)
Environmental ethics	2.973** (0.937)
Animal ethics	1.905** (0.707)
Meat group	1.072 (0.566)
Age	-0.029 (0.017)
Female	0.039 (0.579)
University	0.578 (0.596)
Income	-0.194 (0.168)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Table 2.6: Intention to buy higher animal welfare products in presence of the technology-based label

We can observe that the intention to buy animal foods produced with higher animal welfare standards increases significantly with participants' factual knowledge, health motivation, as well as environmental and animal ethics. These findings suggest that knowledgeable participants are more willing to change their purchasing behaviour in presence of the new label. Moreover, we observe that both egoistic (health motivation) and altruistic (concerns for the environment and animals) drivers affect positively the intention to purchase animal foods produced more ethically. These results seem in contrast with those in Table 2.5 and shall be explored in future

analysis.

2.5 Discussion and conclusion

This study provides preliminary evidence on consumer attitude towards a technology-based animal welfare label linked to precision livestock farming (PLF) technology. The hypothesis is that a label based on precision livestock farming data would provide consumers with more transparent and verifiable information on animal welfare standards, ensuring better reliability of the label, which is essential to increase consumer trust and stimulate ethical purchase.

We conduct ordered logistic regression analysis to investigate the effect of participants' characteristics and of the technology-based label under study on participants' attitude towards animal welfare labels. In contradiction with our hypothesis, the analysis shows that the new label does not affect participants' attitude in the direction expected, as overall its effect is non-significant, while in one case it influences negatively one attitude dimension. A possible explanation for the absence of a significant positive effect of the new label on trust could be that the concept of precision livestock farming is still largely unknown to consumers, which would result in uncertainty and lower trust than it could possibly create in a future when these technological developments are clearer to the general public. Moreover, the label is not implemented yet and this may have caused misunderstanding of the label or overestimation of usage difficulty among participants. In fact, the label was presented to participants by means of a verbal description and some simplified technological features. Specifically, participants could select the most important animal welfare parameter in order to obtain a sub-selection of suitable products, thereby experiencing (partially) the support of a technological label. Additionally, the absence of an implemented link to precision livestock farming data can further explain the low appreciation of the label's potential by participants, which could not fully try the innovation of the label.

Our findings show that the knowledge of animal farming and welfare standards is a predictor of a positive attitude towards the technology-based label, suggesting that it could be more useful for those who are already interested in the matter. Personal attitude towards the environment and animals in general are also positive drivers of participants' attitude, meaning that those who are already sensitive to environmental and animal issues would be more willing to use the technology-based label. These results suggest that a technology-based label as the one that we propose would be highly demanding in terms of infrastructure and costs but not effective in attracting the average consumer. However, we acknowledge that the analysis has serious limitations that do not allow to obtain conclusive evidence. In par-

ticular, the sample size is limited and may suffer from selection bias, and the hypothetical setting of the study cannot capture the attitude of participants as if the PLF label was implemented. In addition, the within-subject structure of the analysis is prone to correlation of participants' pre-existing bias, which should be corrected in further studies by analysing preferences of two separate groups of respondents.

Starting from these preliminary findings further research is needed to understand whether the proposed label would modify consumers' habits and stimulate purchase of animal foods produced with higher animal welfare standards also for those who are now less concerned or less knowledgeable about it. Complementary analysis of other stakeholders' appreciation of the technology-based label, such as producers and retailers, will help define its probability of success and efficacy.

The survey includes qualitative evidence such as comments and critics which will be further analysed with a focus on the marketing implications, which are beyond the scope of this study.

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CHAPTER 3

Search process in online environments and the effect of energy cost information disclosure

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Abstract

This study provides an empirical analysis of search behaviour of household appliances in online environments. We develop several indicators of search intensity and we find a high degree of consumer heterogeneity, although patterns can be identified. We observe that buyers on average spend more time browsing and view more options than non-buyers, suggesting that they are characterised by higher search intensity. We expand the analysis by exploiting a natural experiment on refrigerators to investigate the impact of energy cost information on search behaviour. Our findings suggest that energy cost information affects search intensity differently based on the consumer initial preferences. In particular, customers who start their search from less efficient refrigerators (A+ or below) increase their time effort in searching when energy cost information is disclosed. On the contrary, customers with initial preferences for products in the lowest and highest price quartiles reduce their search intensity when information is disclosed. Moreover, we analyse the dynamics of search and observe that in presence of energy cost information the variability of price decreases, and to a lesser extent also the variability of energy class and time spent by view order decrease. In order to better ascertain the effect of this intervention it will be necessary to further investigate consumer heterogeneity and how to correctly account for it.

3.1 Introduction

Understanding how consumers search is crucial for the design of marketplaces and information disclosure policies. Online marketplaces offer data with a high-level of granularity that can be used to investigate consumer behaviour and test specific hypotheses of how consumers allocate their scarce attention. This study contributes to the existing literature with an empirical analysis of online search of household appliances with a focus on the effect of energy information disclosure on refrigerators.

Well before the digitalisation of markets, search behaviour has been a topic of interest to economists. Search frictions are omnipresent in a large number of contexts, including labour markets, retail, and financial markets. Characterising and quantifying these frictions is crucial for the design of policies. Two different theoretical models of search, the fixed sample size search model by Stigler (1961) and the sequential search model by McCall (1970), have been alternatively validated in empirical analyses (Blake et al., 2016). Notably, using a large panel of online consumers, De Los Santos et al. (2012) find that the fixed sample size search model correctly captures search behaviour. Furthermore, Koulayev (2014) show that effort costs emerge as an important driver of search decisions and as such tools reducing search costs, for example showing a selection of products, benefit consumers (Kim et al., 2010).

In the retail sector, understanding search behaviour is particularly relevant to design information-based policy such as voluntary or mandatory information disclosure programmes. Indeed, providing information on policy relevant product characteristics can modify search behaviour and ultimately purchase outcomes. Understanding how consumers allocate attention when new information is provided is important to design and target new policy interventions. An interesting case study is that of home appliances due to the environmental and welfare implications of energy consumption and attached savings (Houde, 2014). In Europe households account for around 26% of final energy consumption, among which 14% due to home appliances and lighting¹, making information policy necessary for the promotion of greener consumption.

Nonetheless, there is limited evidence on the impact of energy information disclosure policy on search and in particular on how energy information influences consumers' attention allocation in online environments (Sallee, 2014). Moreover, recent studies show that 80 to 90% of consumers search online before making a purchase either online or in-store². Previous evidence shows that consumer attention to energy information varies as well as the impact of such information on purchases. Interestingly, Houde (2014) shows

¹Source: ec.europa.eu/eurostat.

²See for example research from Salesforce and Publicis.Sapient or by GE Capital Retail Bank.

that some consumers value durables with energy label³ beyond the savings due to energy efficiency, while others are more responsive to information on the actual cost of electricity. The same study finds that energy information provision make consumers more willing to pay for energy efficient appliances especially when they have scarce knowledge of true energy costs. D’Adda et al. (2020) find that providing more transparent and salient information on energy cost, not only in kWh but also in Euro, results in less efficient purchases of home durables, suggesting that consumers usually overestimate the savings attached to energy efficiency. Similarly, Andor et al. (2020) finds that consumers overestimate the value of energy labels but, on the contrary, shows that cost information stimulates purchase of more efficient appliances. The study by He et al. (2020) finds that energy information provided in categorical measures is likely to induce heuristic in the decision making: consumers focus on the energy class but do not really understand the energy use implication of home appliances and their reaction will depend on previous literacy and attitude. What emerges is a general lack of knowledge on energy costs and consequently of operational costs of home durables, which could improve with provision of transparent energy information.

The first part of the present study provides an overview on search patterns for different categories of home durables. For this purpose, search metrics are calculated across appliance categories, energy classes, and price quartiles, by splitting customers into two categories based on whether they make at least one purchase (buyers and non-buyers). Durables included in the analysis are: refrigerators, washing machines, dishwashers, dryers, washer-dryers, horizontal, and vertical freezers.

The second part of the study follows up on the analysis by D’Adda et al. (2020) and uses experimental data on refrigerators to expand the analysis on search behaviour when energy cost information is disclosed. In the experiment carried out during the study period two types of energy cost information are randomly provided to online customers: 1-year energy cost information and 15-year energy cost information, which refer to the usage cost of energy for one year and for the refrigerator’s lifetime respectively⁴. The exogenous variation in energy cost information allows us to investigate the impact of the treatment(s) on search intensity. We examine the dynamics of the search process by providing an overview on the characteristics of refrigerator views in terms of price, energy class, and time spent conditional on energy cost information disclosure.

In particular, the analysis of search behaviour across appliance categories shows that customer heterogeneity is very high, but allows to identify search

³In this case the label is the Energy Star voluntary certification.

⁴Calculated to be approximately 15 years. See D’Adda et al. (2020) for more details.

patterns across buyers and non-buyers, as buyers are characterised by higher search intensity. Our experimental results show that the effect of information is not uniform across customers and strongly depends on their initial preferences for energy class and price. Moreover, via a dynamic analysis based on product view order, we show that information reduces volatility in prices and energy classes of the refrigerators viewed by treated customers along time.

3.2 Data and sample

To process and clean the data, we follow closely the approach used by D’Adda et al. (2020) in which the authors conduct a field experiment on the website of one of the major Italian online retailers. Data on navigation and purchase are available for all customers that browsed the website during the experiment, which has been carried out in 2018 between June 1st to October 16th, and consists of one observation per page view for all home appliances relevant to this study⁵.

Customers are identified through their registration ID, which is however not mandatory to navigate the website but only to make a purchase. For customers who are not logged-in, we use cookie-based identification codes, linked to the computer’s IP address and browser. Often, a customer will first browse without logging in, resulting in observations with a cookie-based ID but no registration ID. If the customer does log in at least once, it is possible to match the cookie-based ID to the registration one. The remaining customers, those who never register or log in, are identified through their cookie-based ID. As the authors explain, this identification method may be prone to two main types of errors: first, different identification codes may be assigned to the same customer if she/he never logs in and erases the cookies or uses different browsers or computers; second, the same ID may be assigned to different customers if they never log in and use the same shared computer and browser. These errors should have a similar distribution across the control and treatment groups and therefore they should not represent a problem for the analysis of the treatment effect. However, these errors could have different prevalence between buyers and non-buyers, as buyers must register. Nevertheless, we do not expect many customers to erase cookies and as such the problem should be limited.

The analysis relies on the combination of different datasets. The first dataset contains navigation data, where each observation corresponds to one page view; the second dataset contains information taken from the product catalogue; the third dataset contains daily price information⁶; the fourth

⁵Refrigerators, washing machines, dishwashers, dryers, washer-dryers, horizontal and vertical freezers.

⁶Prices vary daily and even within the same day based on (i) the availability of a

dataset contains municipal-level data on population, income, education, and other socio-economic characteristics from Guiso et al. (2016).

We then combine these four datasets to build a user-level dataset which contains variables for both purchase and navigation outcomes. The final dataset includes details on the type of page visited (listing page, which displays all products available according to the filters selected, product page, which reports specific characteristics of products, cart page corresponding to the customer's cart page, etc.), the time of page visit, and the number of seconds spent viewing the page. Starting from these data we calculate additional indicators of search intensity, including the total number of pages viewed, the overall time spent on the website in seconds, the number of product pages viewed, the number of appliances added to the cart, and the number of those ordered. Each product in the dataset is identified by a unique product code which is attached to additional information such as product description, product brand, energy class, yearly consumption in kWh, and corresponding yearly and lifetime energy costs in Euro. We use the user's IP address to add municipality information from Guiso et al. (2016) to the dataset.

The sample includes 149118 customers among which 138060 non-buyers and 11058 buyers. Buyers are customers who have purchased at least one appliance within one of the categories of interest in the study period. By construction the sample includes customers who view at least one refrigerator, so we do not observe the behaviour of customers only interested in other appliance categories. Details are reported in Table 3.1.

Table 3.1 reports the total number of distinct products in the catalogues and those viewed by customers, as well as the number of buyers and non-buyers. The table shows that refrigerators represent the most numerous category, as expected given the construction of the sample. Similarly, the distribution of customers and buyers across appliance categories is in line with the sample composition.

product in stock; (ii) the competitors' prices, which are automatically matched by an algorithm; and (iii) offers activated on the basis of a product's category or state: for instance, offers on air conditioning are generally activated in correspondence with higher temperatures.

Appliance category	Catalogue	Products viewed	Customers	Buyers
Refrigerators	2016	519036	1396543	8765
Washing machines	870	147476	164210	1554
Dryers	261	15855	55590	442
Vertical freezers	175	14863	40654	278
Dishwashers	302	10818	35673	340
Washer-dryers	102	9627	30935	288
Horizontal freezers	153	6329	17759	165

Table 3.1: Total number of distinct products in the catalogues, total number of distinct products viewed by customers, number of users viewing products, and number of buyers by appliance category

3.2.1 Experimental design on refrigerators

Customers viewing refrigerator pages on the retailer’s website during the study period are randomly assigned to one of the three following groups: (a) the 1-year treatment group, in which users are provided with information on the yearly energy usage cost of each product in Euro; (b) the 15-year treatment group, in which users are provided with information on the lifetime energy usage cost of each product in Euro; and (c) the control group in which users see the retailer’s default product visualisation, with no information on energy costs in Euro. Random assignment to one of the three groups is performed by a cookie-based software routinely used by the online retailer for AB tests. Each customer is assigned to one of the three treatments on her/his first visit to the retailer’s website during the study period. As explained above, the same user could receive different treatments if she/he erases cookies and/or does not always log in when browsing. In such cases, we consider the modal treatment.

All products display an icon reproducing the energy class symbol contained in the energy label, while energy cost information is only provided to customers in the treatment groups. The choice to place the information close to the icon aims at increasing transparency and linking the additional information to the energy class of the product. The sentence is formulated as follows: “*you spend X Euro for energy in 1 year/15 years*”, depending on the treatment group.

Energy cost information is provided in two places on the website: (a) on product listing pages, where products are displayed in a list: here, the information on a specific product appears when the customer hovers the mouse over it; and (b) on product pages, where a single product is displayed in detail. Customers could click on the cost information sentence and a pop-up window would explain the nature of the information and the sources of data for energy cost and refrigerator lifetime. Appendix A in D’Adda et al. (2020) contains screenshots of pop-up messages by treatment and provides

details on energy cost calculation.

3.3 Search metrics

In this section, we investigate search patterns in all appliance categories under study. We develop several indicators of search intensity with the aim of identifying the relationship between appliance attributes and online search behaviour. In particular, Table 3.2 reports the overall number of products viewed, time spent online, and time spent on product pages across appliance categories.

Appliance category	Products viewed			
	Non-buyers		Buyers	
	Average (SD)	Median	Average (SD)	Median
Washing machines	9.39 (13.55)	5	12.94 (14.25)	8
Dryers	7.2 (9.01)	4	11.87 (11.82)	8
Refrigerators	10.67 (16.6)	6	22.22 (34.56)	14
Washer-dryers	4.86 (4.96)	3	10.87 (9.45)	9
Dishwasher	5.44 (5.86)	3	8.95 (7.72)	7
Vertical freezers	6.46 (5.82)	5	10.3 (6.64)	9
Horizontal freezers	5.31 (4.96)	4	8.67	8

Appliance category	Total time browsing			
	Non-buyers		Buyers	
	Average (SD)	Median	Average (SD)	Median
Washing machines	10.84 (26.27)	2.1	42.47 (49.09)	27.73
Dryers	9.96 (25.45)	1.81	41.22 (48.91)	27.75
Refrigerators	9.54 (22.62)	2.2	52.90 (61.92)	35.76
Washer-dryers	7.71 (18.26)	1.35	53.60 (85.23)	29.27
Dishwasher	7.94 (18.42)	1.62	38.27 (38.57)	26.10
Vertical freezers	7.52 (16.97)	1.75	38.03 (32.07)	28.04
Horizontal freezers	6.04 (12.95)	1.3	31.07 (38.88)	18.57

Appliance category	Time on product pages			
	Non-buyers		Buyers	
	Average (SD)	Median	Average (SD)	Median
Washing machines	8.75 (22.06)	1.63	20.73 (35.13)	9.37
Dryers	8.06 (20.28)	1.43	19.58 (36.41)	7.25
Refrigerators	0.94 (6.47)	0	3.59 (15.14)	0
Washer-dryers	6.46 (15.18)	1.2	30.11 (71.32)	9.1
Dishwasher	6.37 (14.69)	1.32	17.97 (25.87)	6.84
Vertical freezers	6.64 (14.63)	1.57	22.02 (26.28)	13.11
Horizontal freezers	5.07 (10.96)	1.22	15.91 (33.81)	5.85

Table 3.2: Number of products viewed, time spent browsing and time spent on product page in minutes.

Average values with standard deviation in parentheses, median values.

As we can see, on average, buyers view more products and spend more time browsing the website and viewing product pages than non-buyers. Given the magnitude of the standard deviation, we also consider the median values, which confirm this difference. This allows us to say that buyers are characterised by a higher search intensity, measured in terms of variety of

options viewed and time spent on the website, and this trend remains valid across appliance categories.

Appliance category	Average price of products viewed			
	Non-buyers		Buyers	
	Average (SD)	Median	Average (SD)	Median
Refrigerators	679.8 (291.56)	544.94	586.82 (223.79)	512.39
Washing machines	438.27 (242.29)	371.69	413.5 (182.78)	371.69
Dryers	627.54 (264.31)	539.69	609.26 (207.64)	543.89
Vertical freezers	429.81 (280.24)	331.79	433.75 (229.29)	435.74
Dishwasher	450.02 (172.56)	400.04	445.33 (155.29)	400.04
Horizontal freezers	280 (116.66)	266.69	284.92 (90.99)	281.39
Washer-dryers	627.80 (291.56)	544.94	586.96 (223.79)	512.39

Table 3.3: Average price in Euro

Table 3.3 reports prices of appliances viewed by non-buyers and buyers, showing that on average buyers view less expensive products. The difference is more pronounced for more expensive appliances, such as refrigerators and washer-dryers. The t-test comparing number and price of products viewed by buyers and non-buyers has in both cases p-value very low ($p < 0.001$) rejecting the hypothesis that the two types of consumers are equal. One possible explanation for this difference is that customers visit the online marketplace with different intentions. Some will navigate the website only to gather information on prices and product attributes, some also to make a purchase in store or at a later date, while others to make an immediate purchase. Considering the nature of the products under study, it is unlikely that customers decide to make a purchase if that was not their original intention and, given that original intentions will strongly affect the search process, it is important to distinguish between the two types of consumers. We expect buyers to be a homogeneous group, while non-buyers will present heterogeneous intentions. As an example, the reason for the higher average price of products viewed by non-buyers could be due to the fact that some are less concerned to look for products within their budget as they will not actually make a purchase.

We continue this analysis by looking at the energy class heterogeneity. We consider four different subgroups corresponding to different energy classes and we look at the fraction of time spent as well as the fraction of products viewed in each subgroup⁷. We observe high correspondence be-

⁷The energy classes are categorised into four broad classes following D’Adda et al. (2020): class 1 corresponds to energy class A+++ and above, class 2 corresponds to energy class A++, class 3 corresponds to energy class A+, and class 4 corresponds to energy class A and below. All products in the washer-dryer category belong to the lowest energy class considered here (A or below).

tween the number of products viewed and the time spent within a specific energy class, this suggesting that there is a linear relationship between the two dimensions. The majority of products viewed and time spent fall within the A+ and A++ energy classes, and this holds across appliance categories with the exception of washing machines that have more than 85% of observations falling in the highest energy class A+++ (or above). This is also motivated by the choice set of products across appliances: the majority of the washing machines in the catalogue are in the A+++ energy class, and therefore this affects the distribution of views in our sample.



Figure 3.1: Heterogeneity by energy classes



Figure 3.2: Heterogeneity by price quartiles

We repeat the same analysis across appliance categories by considering four subgroups corresponding to the four price quartiles. Figure 3.2 shows a positive correlation between the time spent viewing products in a given price quartile and the number of products viewed in the same. Similarly to what we observe in Figure 3.1, heterogeneity is similar between buyers and non-buyers.

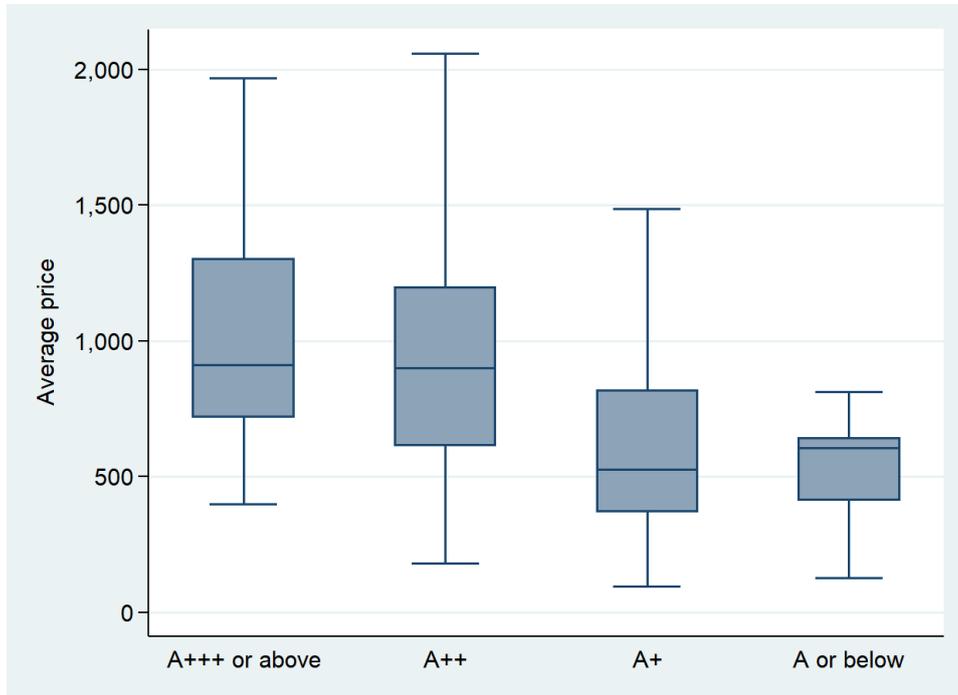


Figure 3.3: Relation between energy class and price in Euro for refrigerators.

Figures 3.1 and 3.2 show that buyers and non-buyers are characterised by similar heterogeneity in terms of preferences for energy class categories and prices (grouped by price quartiles). We can also observe that the distribution across the four categories analysed shows some differences, suggesting that energy class and price quartile do not correlate perfectly.

In order to better visualise this dependency, in Figure 3.3 we show the relationship between energy class and price for refrigerators: as we can see from the graph the price tends to increase as the energy efficiency improves, however there is a significant spread in the prices around this trend. This result also holds for other appliance categories showing that the energy class is not the only determinant of price.

3.3.1 Search dynamics

We examine the dynamics of the search process with respect to three dimensions: time spent looking at products, price, and energy class based on the order of products viewed. Here, by order we mean the sequence of product pages visualised including repetitions. As an example, if a customer visualises products A and B in the order A, A, B, A, we will consider as her/his order the sequence A, B, A. We use this definition as it allows us to include customers returning to the same product. If two pages belonging to the same products are visited one after the other, then we sum the time

spent and consider it as a single visit.

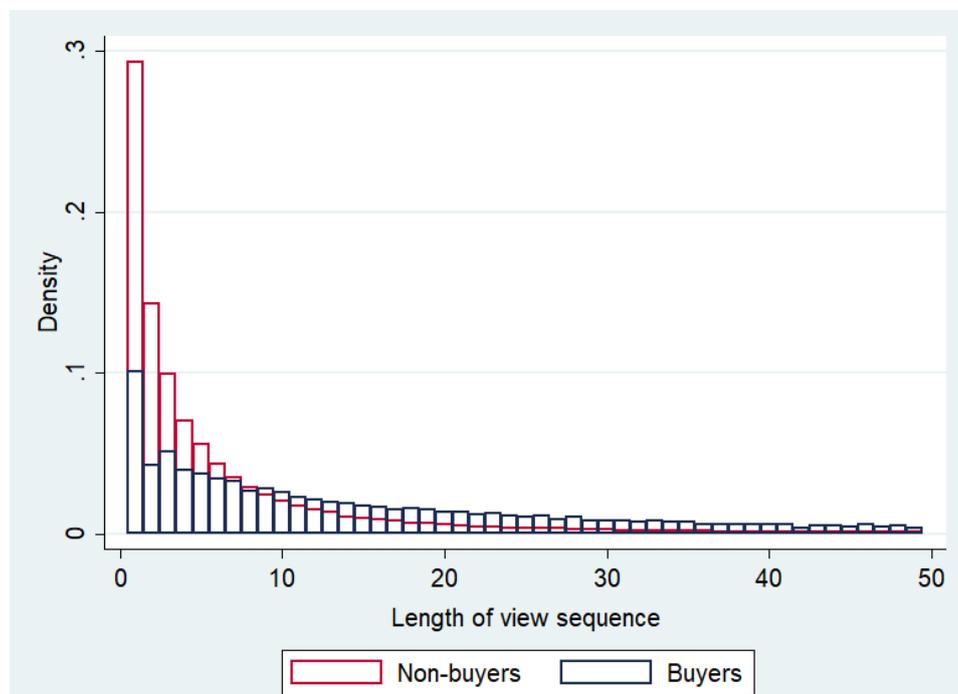


Figure 3.4: Number of customers by product view order

Figure 3.4 shows that the distribution of the length of view sequences is different between buyers and non-buyers. We can see that buyers are more likely to have longer search processes. Recall that by our definition of the view sequence, this can either be due to repeated views of the same pages or by a higher number of options considered. In both cases, we can say that buyers show a higher search intensity. It is interesting to note that both distributions do not have a characteristic length, as they are not centered around the mean. The fact that approximately 10% of buyers stop their search after viewing a single product suggests that a part of customers have made a decision prior to navigating the website. However, the wide distribution suggests that search costs vary considerably across customers. This seems in contradiction with the fixed sample size model of search, however this claim should be further investigated to better model the search behaviour observed.

Next we investigate the temporal dimension of the search process. We aim at understanding how the consumer refines the product characteristics along the search. In the next figures, we show the dynamics of search up to the 50th product page visualisation in terms of price, energy class, and time spent.

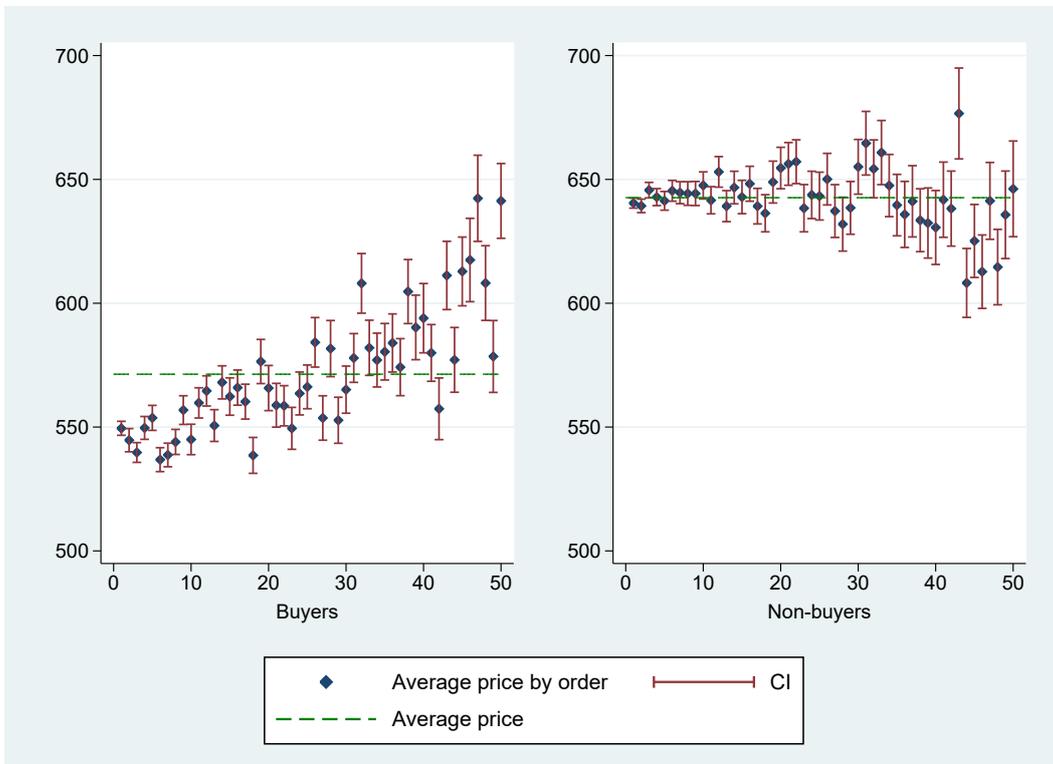


Figure 3.5: Average price by view order

Figure 3.5 shows that prices of products viewed by non-buyers are on average higher ($p\text{-value} < 0.001$), while buyers show an increasing trend along the search. The reason may be that only committed buyers, i.e. those who view more options, move towards products with higher prices along the search process possibly due to information acquisition and/or preference refinement during the search. Another option could be that initial price preferences correlate strongly with the maximum length of the search sequence. Dispersion around the mean increases with view order as the number of customers decreases.

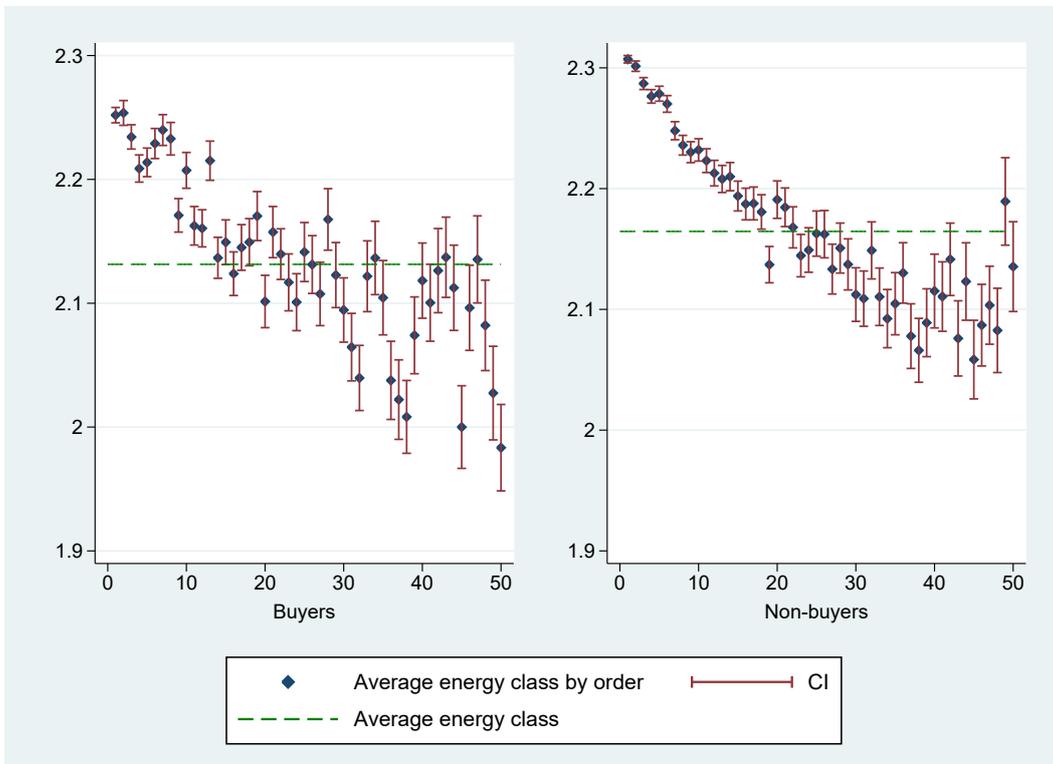


Figure 3.6: Average energy class by view order

The average energy class of products viewed by non-buyers is slightly and significantly higher (meaning less efficient; $p\text{value} < 0.001$). The trend of non-buyers is monotonically decreasing especially in the first part of the search, while this trend is less evident for buyers. Nonetheless, the lower limit of energy class of products viewed by buyers is lower (recall that 2 stands for A++, and 1 stands for A+++ or above). The graph shows that dispersion is higher for buyers, and increases for non-buyers alike approximately after the 20th view.

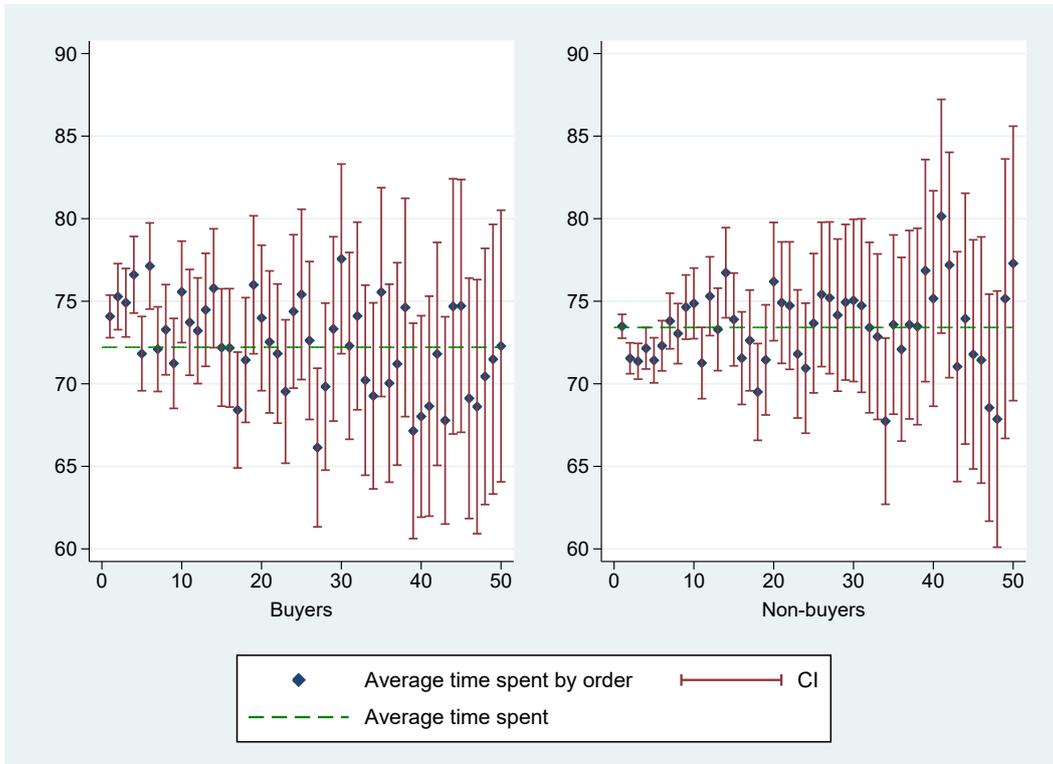


Figure 3.7: Average time spent (in seconds) by view order

Figure 3.7 shows that the average time spent by product view order is similar and there is no significant differences between the two cases. The graph shows that all data points are approximately concentrated around the average, with increasing levels of variation. Buyers show a slight decreasing trend along the search. However, given the confidence intervals, it is not possible to establish a clear relationship between view order and time spent.

3.4 Experimental analysis: case study on refrigerators

In this section we analyse search behaviour in response to two different types of information disclosure on energy cost.

3.4.1 Search dynamics with energy information disclosure

In the following graphs we report trend in average price (Figure 3.8), average energy class (Figure 3.9), and average time spent in seconds (Figure 3.10) by view order up to the 50th view.

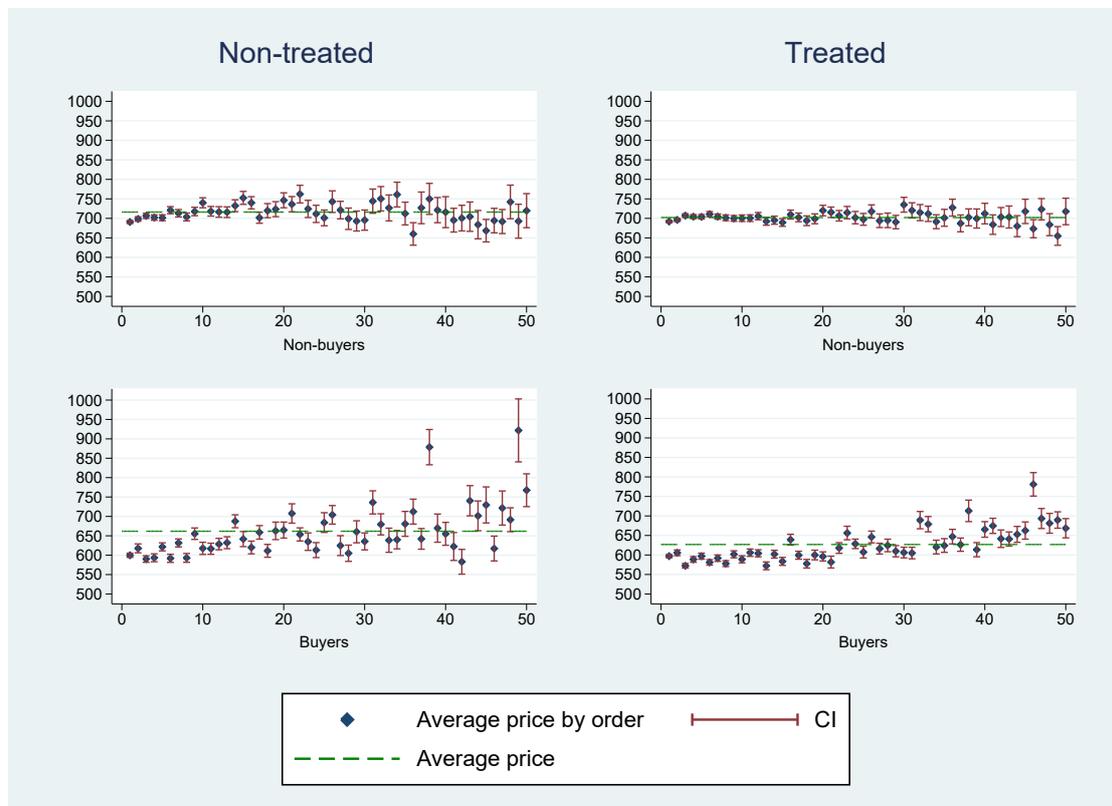


Figure 3.8: Average price by view order

Figure 3.8 shows that the average price is lower for buyers, confirming previous figures. Similarly, average price for treated customers (buyers/non-buyers) is lower. Both these differences are statistically significant (p -value < 0.001), though the magnitude is much bigger in the first case ($\Delta = 84.70$ euro) than in the latter ($\Delta = 13.70$ euro). The dispersion is lower at the beginning of the search process and increases afterwards, and it is generally lower for buyers. We can observe that buyers start viewing refrigerators with average price (by order) below the sample average price and then move to more expensive refrigerators along the search, similarly to what we observe in Figure 3.5, while this trend is not visible for non-buyers. The graph also shows that price variability by product view order is reduced in presence of energy cost information (for treated customers).

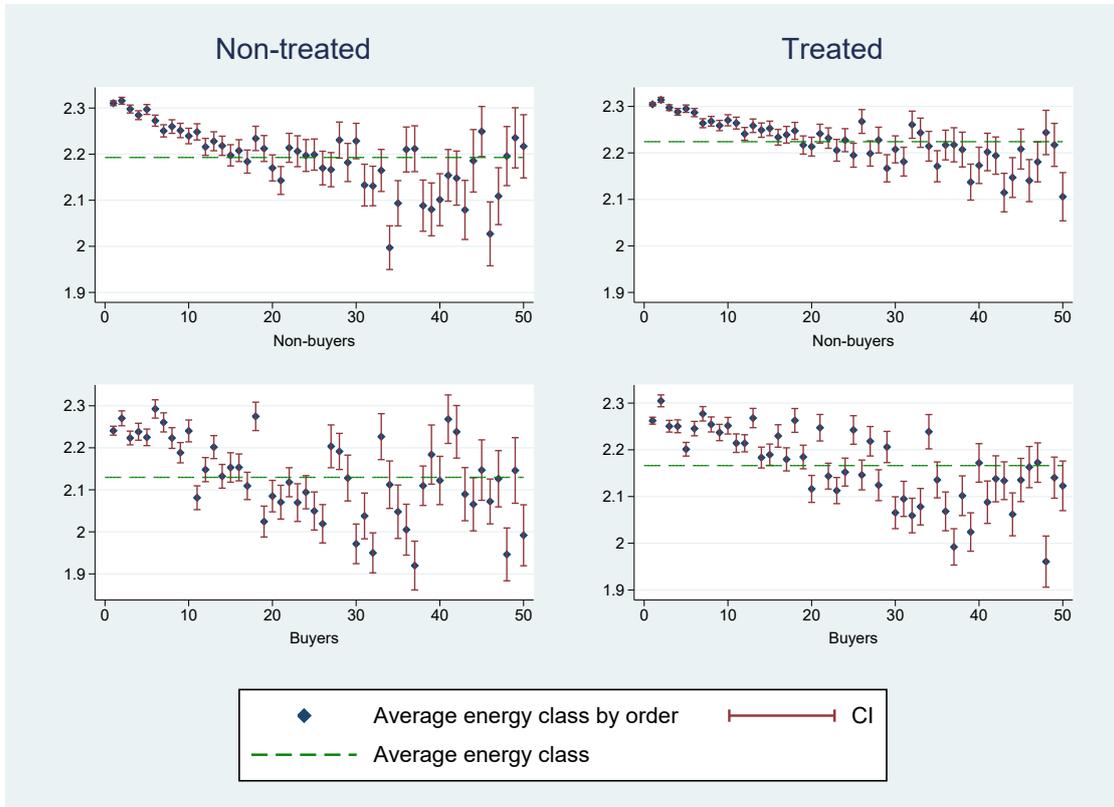


Figure 3.9: Average energy class by view order

Figure 3.9 shows that average energy class of refrigerators viewed by non-treated customers is lower (meaning more efficient refrigerators) and this difference is significant ($p\text{-value} < 0.001$), supporting the hypothesis that customers provided with energy information search for less efficient refrigerators, although the difference in energy class is minimal. We can observe that both treated and non-treated customers on average start their search from products with similar energy class, but the decreasing trend along the search is slower in the treated case. When we compare buyers and non-buyers, we find that average energy class is statistically different ($p\text{-value} < 0.001$) as buyers on average view more efficient refrigerators. The graph shows a decreasing trend for non-buyers (i.e. a shift towards more efficient refrigerators), especially before the 20th product view, which does not apply to buyers. Also in this case, we observe less variability in the energy class by view order in presence of energy cost information.

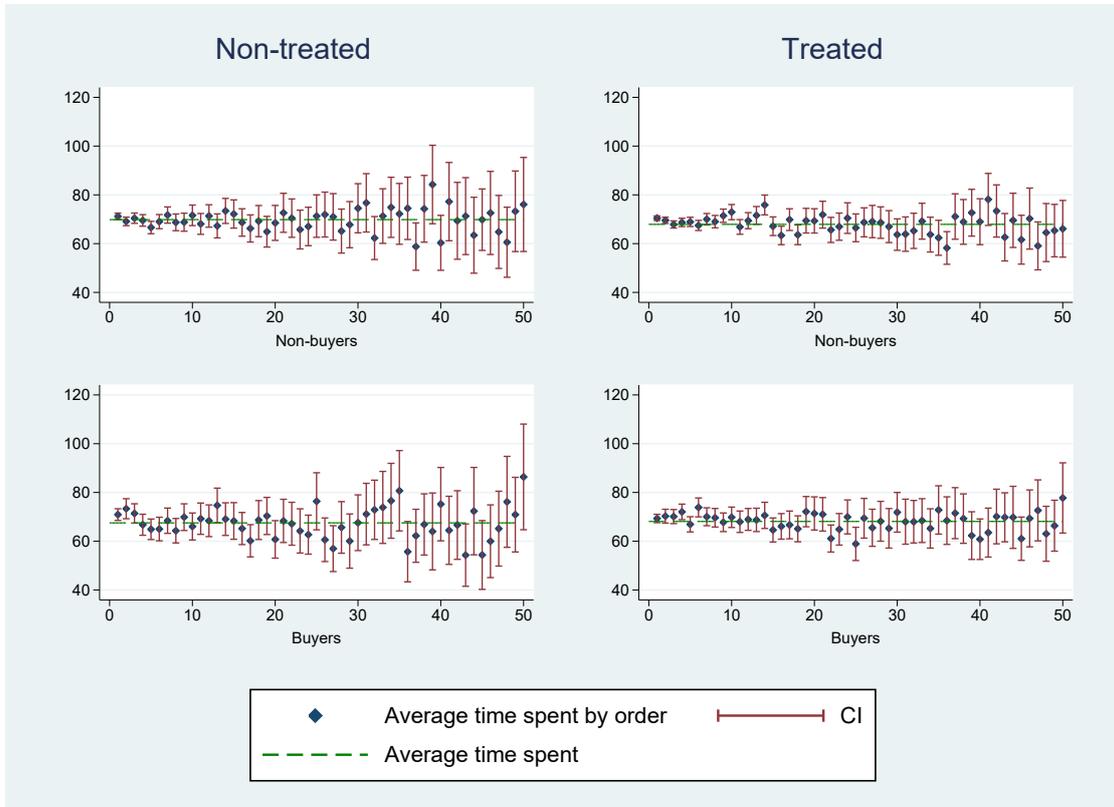


Figure 3.10: Average time spent (in seconds) by view order

Figure 3.10 shows a similar variation around the average time spent by order, which increases with the order number. The average time spent is similar in all four cases and even later in the search, the average values by order do not deviate substantially. The t-test comparing the average time spent by treated and non-treated customers is non-significant, while the t-test comparing the average time spent by buyers and non-buyers shows a significant difference ($p\text{-value} = 0.009$) but negligible in magnitude. Similarly to the two previous cases, we observe that the variability of time spent by view order is slightly reduced in presence of energy cost information.

The analysis of the dynamics of search by product view order shows that the provision of energy cost information reduces variability in terms of price, energy class, and time spent. Further analysis will help better explain these trends.

3.4.2 Cross section analysis

Following the methodology in D’Adda et al. (2020), we use linear regression analysis to investigate the effect of energy information disclosure on search intensity.

We start by considering the following model:

$$y_i = \beta_1 + \beta_2 treat_i + \lambda_t + \gamma_m + \epsilon_i \quad (3.1)$$

where y_i represents the search intensity measured by several outcome variables: (i) the average total seconds spent browsing the website, (ii) the average time spent on a generic page (which includes all types of pages related to a product); (iii) the average time spent on a product page (which displays the technical details of a product); (iv) the total number of products viewed, (v) the number of repeated visits to the same product; and (vi) the number of visits to the website⁸. We also estimate the treatment effect on the (vii) probability of making a purchase. Regressors include the treatment variable ($treat_i$), the categorical variable for municipality fixed effects (γ_m) and the categorical variable for week fixed effects (λ_t). The treatment variable is broken down by individual treatment and included in the regressions as categorical variable with value 0 when there is no treatment, 1 for the 1-year treatment, and 2 for the 15-year treatment.

Results in Table 3.4 and Table 3.5 show that being in either of the two treatment categories has not a significant impact on search intensity.

<i>Dependent variables:</i>				
	Total	time	Time on	Time on
	browsing		generic page	product page
1-year info		0.005	-1.303	-0.136
		(11.491)	(1.181)	(0.455)
15-years info		-3.373	-0.276	-0.350
		(11.691)	(1.211)	(0.473)
Number of Obs		121936	121313	121936
R-Squared		0.034	0.033	0.022
week FE		yes	yes	yes
municipality FE		yes	yes	yes

* p < 0.10, ** p<0.05, *** p<0.01.
OLS regression

Table 3.4: Separate treatment effects on search time intensity

⁸Each visit (session) is consider to last for 60 minutes (1 hour), after which a new session starts.

	<i>Dependent variables:</i>			
	Products viewed	Repeated views	Number of sessions	Purchase
1-year info	0.072 (0.089)	0.028 (0.032)	0.026 (0.021)	-0.006 (0.014)
15-years info	-0.010 (0.087)	0.016 (0.030)	0.007 (0.020)	-0.025* (0.014)
Number of Obs	121936	121936	121936	121936
R-Squared	0.029	0.031	0.044	0.0049
week FE	yes	yes	yes	yes
municipality FE	yes	yes	yes	no

* p < 0.10, ** p<0.05, *** p<0.01.

First three columns: OLS regression, last column: probit regression

In the probit regression we did not include the municipality fixed effects due to collinearity.

Table 3.5: Separate treatment effects on search intensity and purchase

Table 3.5 shows that receiving information on the lifetime energy cost has a slight negative impact (10%) on the probability to purchase a refrigerator, although the effect is very small in magnitude and significance.

We continue our analysis with the aim to exploit heterogeneity of preferences, as we suppose that they are a significant determinant of customer reactions to information disclosure in line with our hypothesis expressed in the discussion of the results in Figure 3.5. Therefore, we include in the specification an interaction term between the treatment(s) and the energy class⁹. Specifically, we include the energy class of the first refrigerator viewed to capture heterogeneity in customer initial preferences for energy efficiency. The choice to interact the treatment with the energy class of the first product viewed aims at including information on initial preferences not affected by the disclosure of energy cost information. Therefore, we consider the energy class of the first refrigerator as a reasonably good proxy of energy preferences, as confirmed by Table 3.6.

We use the following specification:

$$y_i = \beta_1 + \beta_2 treat_i + \beta_3 energyclass_{1i} + \beta_4 treat_i * energyclass_{1i} + \lambda_t + \gamma_m + \epsilon_i \quad (3.2)$$

where all the terms are those explained above with the addition of the energy class of the first refrigerator viewed and the interaction variables. Energy class A+++ or above is the reference category.

⁹In this case, we include refrigerators with energy class A or below, which are very few, in the class A+.

Energy class of 1 st view	Energy class of purchase			
	1	2	3	Total
1	887	210	40	1137
2	322	2210	413	2945
3	113	769	2574	3456
Total	1322	3189	1748	7538

Table 3.6: Energy class of first product viewed and of purchased product (only buyers).
1 = A+++ or above, 2 = A++, 3 = A+ or below

	<i>Dependent variables:</i>			
	Total browsing	time	Time on generic page	Time on product page
1-year info	-50.457 (32.793)		-6.131* (3.452)	0.206 (0.996)
15-years info	-18.318 (36.582)		-6.254* (3.456)	-0.061 (0.949)
A++	-71.812*** (27.646)		-11.559*** (2.822)	-0.355 (0.781)
A+ or below	-220.954*** (26.094)		-19.720*** (2.776)	4.230*** (0.908)
1-year info*A++	32.980 (38.091)		6.243 (3.963)	-0.660 (1.122)
1-year info*A+ or below	85.350** (36.639)		5.364 (3.866)	-0.311 (1.291)
15-years info*A++	-5.141 (41.586)		6.239 (3.980)	0.214 (1.136)
15-years info*A+ or below	39.569 (39.938)		8.038** (3.897)	-0.885 (1.266)
Number of Obs	118166		117544	118166
R-Squared	0.036		0.035	0.024
week FE		yes	yes	yes
municipality FE		yes	yes	yes

* p < 0.10, ** p<0.05, *** p<0.01.
OLS regression

Table 3.7: Separate treatment effects on search time intensity with energy class interaction

Table 3.7 shows that being in either of the two treatment categories has a negative effect on the average time spent on a generic page, which is significant at the 10% level. This suggests that energy information provision slightly reduces the time devoted to search. We can observe that having

preferences for less efficient refrigerators reduces the time devoted to search significantly, while it increases the time spent browsing technical details of products. More interestingly, information disclosure on 1-year energy cost has a significant and positive effect on the total time spent online if initial preferences for energy efficiency are lower (A+ or below) with respect to customers with preferences for more efficient refrigerators. A possible explanation is that customers with low energy preferences value more short-term cost and therefore are more affected by such type of information. Similarly, customers receiving 15-year energy cost information and with initial preferences for less efficient refrigerators significantly and positively increase the average time spent on a generic page, although only by few seconds.

	<i>Dependent variables:</i>			
	Products viewed	Repeated views	Number of sessions	Purchase
1-year info	-0.368 (0.250)	-0.104 (0.088)	-0.020 (0.057)	-0.055 (0.037)
15-years info	-0.070 (0.286)	-0.000 (0.101)	-0.009 (0.064)	-0.061* (0.037)
A++	-0.364* (0.213)	-0.131* (0.078)	-0.100** (0.048)	-0.090*** (0.030)
A+ or below	-1.073*** (0.204)	-0.324*** (0.077)	-0.271*** (0.047)	-0.111*** (0.029)
1-year info*A++	0.413 (0.290)	0.125 (0.101)	0.039 (0.066)	0.072* (0.043)
1-year info*A+ or below	0.601** (0.281)	0.182* (0.101)	0.067 (0.065)	0.051 (0.042)
15-years info*A++	-0.019 (0.320)	0.001 (0.112)	-0.005 (0.072)	0.043 (0.043)
15-years info*A+ or below	0.113 (0.310)	0.021 (0.108)	0.029 (0.069)	0.050 (0.043)
Number of Obs	118166	118166	118166	118166
R-Squared	0.030	0.032	0.046	
week FE	yes	yes	yes	yes
municipality FE	yes	yes	yes	no

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

First three columns: OLS regression, last column: probit regression

Table 3.8: Separate treatment effects on search intensity and purchase with energy class interaction

We observe in Table 3.8 that the 15-year energy cost information reduces slightly the probability to purchase a refrigerator (10% significance). However, given that the coefficients of the interaction of the 15-years treat-

ment with lower energy classes have opposite sign and similar magnitude, we suppose that the effect is driven by customers with higher energy efficiency preferences (A+++ or above, which is the reference category). This result suggests that customers with preferences for more efficient products as a result of energy cost information disclosure are less likely to make a purchase. Receiving 1-year energy cost information and viewing first product with energy class A++ has a positive and significant effect on making a purchase (10%), in line with what is shown in Table 3.7. These results suggest that information disclosure on energy cost, as it reveals the true operational cost of refrigerators and therefore the true savings associated with energy efficiency, affects the search intensity and probability of purchase of customers conditional on their energy efficiency preferences.

We repeat the same analysis by including a price categorical variable in the specification as follows:

$$y_i = \beta_1 + \beta_2 \text{treat}_i + \beta_3 \text{pricequartile}_{1i} + \beta_4 \text{treat}_i * \text{pricequartile}_{1i} + \lambda_t + \gamma_m + \epsilon_i \quad (3.3)$$

Following the same reasoning applied to energy class, we include the price quartile of the first product viewed and the interaction term between the treatment variable and the price quartile variable. In this case, the quartile represents a proxy of the customer preferences for more/less expensive appliances. This is based on the assumption that customers starting their search in a specific price range are generally interested in refrigerators belonging to the same price range, which is confirmed in Table 3.9.

The reference category is the 1st quartile, representing least expensive refrigerators.

Price quartile of 1 st view	Price quartile of purchase				Total
	1	2	3	4	
1	3171	409	45	12	3637
2	288	1628	172	24	2112
3	65	202	657	92	1016
4	33	58	94	351	536
Total	3557	2297	968	479	7301

Table 3.9: Price quartile of first product viewed and of purchased product (only buyers)

	<i>Dependent variables:</i>		
	Total time browsing	Time on generic page	Time on product page
1-year info	25.029 (17.079)	-1.363 (1.856)	0.191 (0.630)
15-years info	5.687 (17.100)	1.677 (1.940)	0.262 (0.696)
2 nd quartile	138.559*** (20.419)	5.767*** (2.087)	-1.829*** (0.673)
3 rd quartile	55.018** (22.601)	-1.432 (2.389)	5.108*** (1.381)
4 th quartile	-74.535*** (22.602)	-13.608*** (2.455)	-3.046*** (0.712)
1-year info*2 nd quartile	-57.857** (29.460)	-1.042 (2.941)	-0.417 (0.928)
1-year info*3 rd quartile	-4.809 (32.963)	4.063 (3.420)	-0.638 (1.828)
1-year info*4 th quartile	-61.015* (31.665)	-2.511 (3.480)	-0.512 (0.918)
15-years info*2 nd quartile	-5.993 (30.509)	-3.629 (3.029)	0.475 (1.071)
15-years info*3 rd quartile	-34.809 (32.723)	-5.525 (3.406)	-3.676** (1.773)
15-years info*4 th quartile	-5.687 (33.788)	0.376 (3.583)	-0.663 (0.977)
Number of Obs	121936	121313	121936
R-Squared	0.035	0.035	0.024
week FE	yes	yes	yes
municipality FE	yes	yes	yes

* p < 0.10, ** p<0.05, *** p<0.01.
OLS regression

Table 3.10: Separate treatment effects on search time intensity with price quartile interaction

Table 3.10 shows that having preferences for refrigerators in the 2nd and 3rd price quartiles has a positive and significant effect on the time spent online with respect to the reference quartile, while those with highest initial preferences tend to spend significantly less time browsing. This inverse U-shaped dependency between initial price preferences and time spent browsing could be explained in relation to budget constraints: customers with the strongest budget constraint will have limited options, while customers with high price preferences will exclude *a priori* cheaper products. In both cases this will result in less time spent searching as it will be easier to match their

preferences. Customers which start their search looking for products in the 2nd and 3rd quartiles will have more options to compare and it will be more likely that they find roughly equivalent options that require more time to discern. It is less clear the explanation of the effects we observe in relation to the other two dependent variables.

The effect of energy cost information in relation to initial price preferences is overall negative, meaning that search time is reduced. However, the significance of this effect is only clear in the reduction of total time spent browsing by customers with initial preferences for products in the 2nd quartile. This result is somewhat surprising as we would expect customers with stricter budget constraints to be more responsive to energy cost information. It is possible that customers interested in products in the 2nd price quartile might represent the “swing” customers, which react more to new information on energy cost. However, further analysis is needed to ascertain the mechanism behind this effect.

	<i>Dependent variables:</i>			
	Products viewed	Repeated views	Number of sessions	Purchase
1-year info	0.205 (0.134)	0.052 (0.043)	0.030 (0.029)	-0.007 (0.020)
15-years info	-0.006 (0.133)	0.000 (0.042)	0.010 (0.028)	-0.016 (0.020)
2 nd quartile	0.776*** (0.163)	0.261*** (0.052)	0.231*** (0.035)	-0.053** (0.023)
3 rd quartile	0.307* (0.178)	0.192*** (0.063)	0.228*** (0.041)	-0.192*** (0.029)
4 th quartile	-0.516*** (0.173)	0.040 (0.055)	0.098** (0.039)	-0.326*** (0.035)
1-year info*2 nd quartile	-0.246 (0.247)	-0.085 (0.080)	-0.009 (0.053)	0.011 (0.033)
1-year info*3 rd quartile	-0.007 (0.268)	0.043 (0.099)	0.010 (0.061)	0.018 (0.041)
1-year info*4 th quartile	-0.376 (0.245)	-0.056 (0.081)	-0.021 (0.058)	-0.053 (0.050)
15-years info*2 nd quartile	0.038 (0.243)	0.030 (0.078)	-0.009 (0.051)	-0.021 (0.033)
15-years info*3 rd quartile	-0.070 (0.264)	0.002 (0.085)	-0.033 (0.056)	0.023 (0.041)
15-years info*4 th quartile	-0.016 (0.253)	0.058 (0.081)	0.039 (0.059)	-0.062 (0.051)
Number of Obs	121936	121936	121936	121936
R-Squared	0.030	0.031	0.046	
week FE	yes	yes	yes	yes
municipality FE	yes	yes	yes	no

* p < 0.10, ** p<0.05, *** p<0.01.
OLS regression, last column: probit regression

Table 3.11: Separate treatment effects on search intensity and purchase with price quartile interaction

Similarly to the results reported in Table 3.10, we observe the same sign of the effect of initial preferences on search intensity. In this case, we do not observe any significant effect when we interact preferences with energy cost information. This result might confirm that the number of options considered does not depend on the information but rather on consumer characteristics.

3.5 Discussion and conclusion

This study contributes to the literature with an empirical analysis of online search behaviour of several categories of household appliances and by complementing the work by D’Adda et al. (2020) with a study on the effect of energy cost information disclosure on search intensity and search dynamics.

Our investigation on search across appliance categories shows a high degree of heterogeneity in consumer behaviour and purchase choice, but allows to identify some patterns. We find that on average buyers spend more time browsing the website, consider less expensive appliances, and browse many more options than non-buyers. Overall, our findings suggest that buyers have a higher search intensity than non-buyers, reasonably explained by the fact that the initial intentions of purchase matters.

We further explore the relation between consumer initial preferences and search intensity in our experiment on refrigerators. First we note that the provision of energy cost information does not affect uniformly online search. What emerges is that customer heterogeneity overshadows any effect that the new information might have on behaviour. Indeed we observe that initial consumer preferences for energy efficiency and prices are significant predictors of search behaviour in terms of time effort and variety of options considered. We obtain these results by considering the first product viewed as a good proxy of the preferences of the consumer before any information has been collected in the marketplace. In our regression we find that customers browsing more energy efficient products usually devote more time to the search process and have a higher search intensity. Furthermore, we find that search intensity is reduced for customers with preferences for products in the lowest and highest price quartiles, suggesting that budget constraints might play an important role in this behaviour.

With the analysis on the search dynamics we show that volatility in the price, energy class, and time spent by view order is reduced in presence of information. This suggests that energy cost information reduces search uncertainty. Future research should further explore this finding.

Energy cost information seems to have a significant impact on behaviour only when considered in relation to customer characteristics. We observe that exposure to energy cost information interacted with the initial preferences of the customer is a significant predictor of search intensity. This randomized treatment interacted with customer characteristics does not show a significant effect across all metrics of search intensity. We note that providing information on the yearly energy costs leads to more significant effects on customer behaviour. In particular it reduces the total time spent searching for customers with an initial price preference in the 2nd and 4th quartiles, where the 4th is the highest. On the contrary it increases both the time spent and the number of products viewed for customers that start their browsing from a refrigerator with an energy label class of A+ or below. These results

suggests that providing energy cost information will lead to different results depending on the initial preferences of the consumer. Moreover, the analysis of search dynamics shows that price variability and, to a lesser extent, also variability in energy class and time spent by product view order are lower for customers who received energy cost information. Further research will further explore this trend.

Previous studies have shown that a general lack of knowledge of operational energy costs is widespread across the population and that the purchase of energy efficient appliances is sometimes driven by biased saving expectations. When energy cost information is made more transparent and salient this alters consumer choice driving it towards less efficient products (D'Adda et al., 2020). With our analysis we further show that this information will change the search effort but that this effect is significant only in relation to the initial preferences of the consumer. Future extensions of the analysis will consider alternative modelling to better capture and explain heterogeneity.

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Appendix

The following pages contain the text of the survey discussed in Chapter 2.

Intro & static label: meat

Thank you very much for your willingness to participate in this survey.

The aim of this survey is to explore your preferences on farm animal welfare and the role of technology in a shopping environment.

The survey will take approximately 15 to 20 minutes of your valuable time. A prize will be raffled among all participants, so by completing the survey you will have the chance to win a voucher to spend online. To participate, please register your email at the end of the survey!

If you would like to acquire more information about this study, please do not hesitate to contact us after completing the survey.

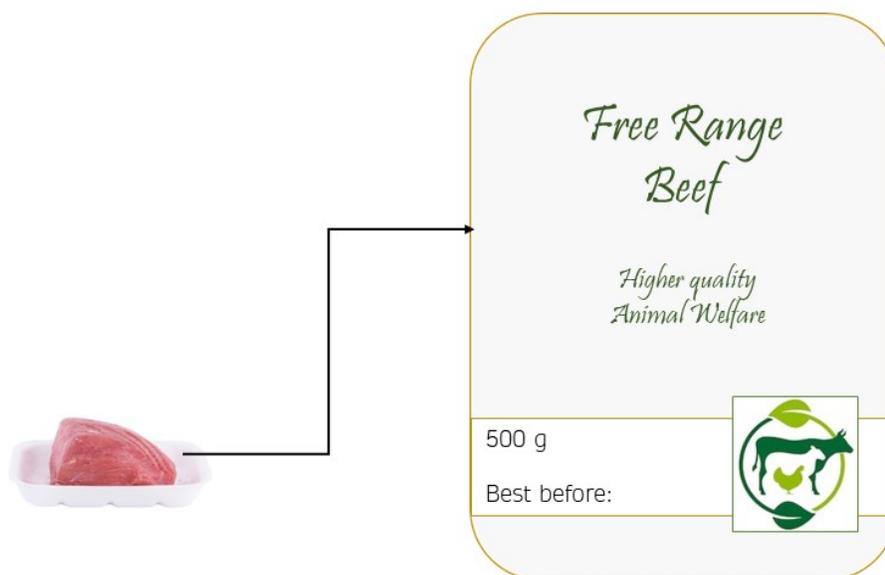
Note: The survey is also suited to be completed on a phone. However, if you have the chance to fill it in on a computer, please do so. The information collected will be treated in compliance with the privacy law and will be used for scientific purposes only.

Imagine yourself in a shopping environment. You would like to buy meat for you and your family. Whilst scanning the meat products, you recognise that there are products with an animal welfare label. The label is approved and guaranteed by the Animal Protection Association of your country.

The label contains the following information and refers to the following farming standards:

- Calves spend at least 5 months with their mother
- In the stable, each animal has a space of 6.6 m² and a shelter with straw
- Animals have access to outdoor grazing for 6 months per year

If you want, you could find additional information on the label's website.



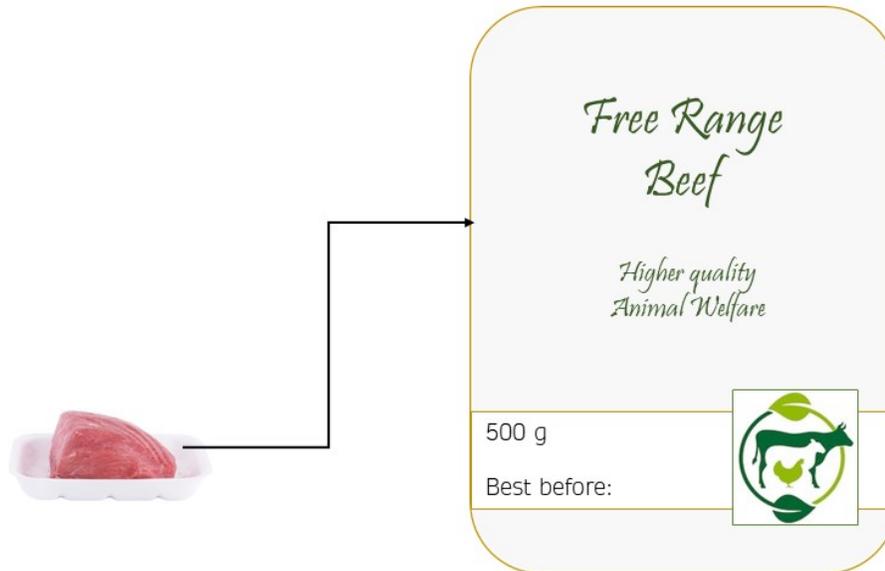
These page timer metrics will not be displayed to the recipient.

First Click: 0 seconds

Last Click: 0 seconds

Page Submit: 0 seconds

Click Count: 0 clicks



Why would you buy the labelled product with respect to a corresponding product without the label?

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I consider this product healthier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider this product safer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider this product more environment-friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider this product more animal-friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would consider the label to be decisive for my purchase decision	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

Related to animal based products with the label

	Not at all (1)	2	3	4	5	6	Very much so (7)
I would feel a lot of uncertainty when making my decision	<input type="radio"/>						

	Not at all (1)	2	3	4	5	6	Very much so (7)
I wouldn't feel any uncertainty while making my choice	<input type="radio"/>						

Please answer the following question:

	Very uncertain	Uncertain	Somewhat uncertain	Neither uncertain nor certain	Somewhat certain	Certain	Very certain
When making a choice based on the label, would you feel very certain or very uncertain about the outcome?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The presence of the label makes me feel confident that I can access information about a product at any time to make an informed choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The presence of the label allows me to find information about a product that I don't know myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The presence of the label makes me feel that even if I don't know some information about a product right away, I know that I can access it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer the following questions:

	Not at all (1)	2	3	4	5	6	Very much (7)
How much do you think you could count on the label?	<input type="radio"/>						
How much do you think you would trust the label?	<input type="radio"/>						
How dependable do you think the label would be?	<input type="radio"/>						

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I believe that my interaction with this label is clear and understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy for me to use this label	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find this label easy to use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

In relation to animal based products

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor	Somewhat agree	Agree	Strongly agree
--	-------------------	----------	-------------------	-------------------	----------------	-------	----------------

	disagree						
Using the label improves my performance in evaluating the products during shopping	<input type="radio"/>						
I find the label to be useful for shopping	<input type="radio"/>						
Using the label enhances my effectiveness in shopping	<input type="radio"/>						

Please indicate how much you agree with the following statement:

The information provided on the label was:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Easy to process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to understand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to comprehend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would choose to buy animal based products with the support of the label to have more guarantees on animal welfare in farming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I normally use the information provided to choose animal based products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I normally rely on my gut feelings when I choose animal based products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I normally spend much time reading labels during my shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Introduction technology-based label (meat)

Introduction of a technology-based interactive label

Recent technological developments have made it possible to collect very specific information on the welfare of farm animals. For instance, instead of an overall score for a brand, a single piece of meat or cheese can now receive a unique set of scores based on a lot of different welfare criteria.

We can imagine that you do not have the time to consider all this information when you go shopping. A solution

for this may be that you use an app to set your preferences regarding animal welfare once. Then, the app helps you by finding the products that fit your welfare preferences.

We present an innovative labelling approach that is able to do this and more: the shared decision-making system. The following summary gives an overview of what the shared decision-making system can offer to you:

- You can obtain information on animal welfare, based on data that is collected continuously through non-invasive sensors at every step of the process from the farm to your plate (for example, on farm, during transportation, etc.).
- You can register your preferences on animal welfare in the system and get support for your purchasing decisions. For example: You wish that the animals have the opportunity to graze outside; if you register this preference in the system (through an app) it will help you to find products that guarantee that the animals have spent time outside their stable grazing on pasture, which are suitable for you and your indicated preferences and requirements.
- If you do not want to set your own preferences, you may also make use of criteria set by organisations committed to animal protection (for example the Animal Protection Association of your country). Subsequently, products are shown that comply with these criteria (as in the previous example). This is particularly useful if you think that you don't know enough about animal welfare standards, or simply don't have enough time to set your personal preferences.
- Through technological instruments like a chatbot, you may interact with actors in the supply chain. This way, you can ask for clarity and additional information.

Shortly describe the shared decision-making system as a support to shopping decisions in your own words

What do you think of the shared decision-making system as a support to shopping decisions related to animal based products?

These page timer metrics will not be displayed to the recipient.

First Click: *0 seconds*

Last Click: *0 seconds*

Page Submit: *0 seconds*

Click Count: *0 clicks*

Please answer the following question.

A shared decision-making system is a:

- Management platform
- Platform to inform consumers
- Marketing strategy
- Online shopping platform

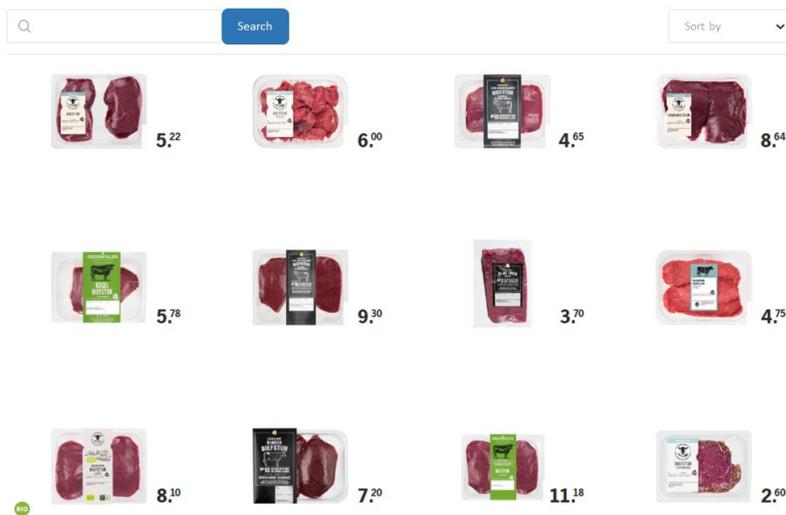
Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would like to use this system when choosing an animal based product	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I very much like the idea of such a system because it would help me find the appropriate products fitting my preferences on animal welfare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

You would like to buy meat for you and your family. Imagine yourself in an online shopping environment where all options are available (have a look at the example below).

In a shared decision-making system, you could select animal welfare criteria and base your shopping decisions on them.

On the next screen, you can try this out with the help of a chatbot.



Chatbot meat

Please choose one of the five options and click on it to answer the chatbot.

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

You chose "space per animal". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Space per animal

Virtual user

I can show you products from animals that each have at least 6.6 m2 of space available in the stable. Would you like to see them?

Show me the products

Bot - Bot

You chose "structure of stable and enriching materials". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Structure of stable and enriching materials

Virtual user

I can show you products from animals that have stables enriched with straw and soft materials. Would you like to see them?

Show me the products

Bot - Bot

You chose "interaction between mother and calves". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Hi, I would like to ask you something

Virtual user

I can show you products from animals from which the calves have spend a minimum of 5 months with their mothers. Would you like to see them?

Show me the products

Bot - Bot

Interaction between mothers and calves

Virtual user

You chose "time outdoor grazing on pasture". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

- Space per animal
- Structure of stable and enriching materials
- Interaction between mothers and calves
- Time outdoor grazing on pasture
- Transportation of live animals

Bot - Bot

Time outdoor grazing on pasture

Virtual user

I can show you products from animals that were free to graze outdoors 6 months per year, 12 hours a day. Would you like to see them?

Show me the products

Bot - Bot

You chose "transportation of live animals". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Transportation of live animals

Virtual user

I can show you products from animals that have been transported for no more than 8 hours. Would you like to see them?

Show me the products

Bot - Bot

Questions after chatbot (meat)

These five products are from different shops, but all meet the requirement that you have selected.

Search results for meat products. The products shown are:

- Product 1: Price 8.10
- Product 2: Price 7.20
- Product 3: Price 3.70
- Product 4: Price 4.75
- Product 5: Price 4.23

Note that this is just an example: in a real life shared decision-making system you will be able to ask every

question you wish.

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would ask questions through the chatbot if I had doubts on the farming practices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would register my preferences on animal welfare to get only suitable products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would choose to buy animal based products with the support of the shared decision-making system to have more guarantees on animal welfare in farming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The chatbot based shared decision-making approach would be very useful for my decision making related to animal based products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the presence of the shared decision-making system, I would switch to more animal friendly products because I would have a guarantee on the animal welfare standards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please rate the importance of the following elements.

The fact that animal welfare standards are guaranteed by the shared decision-making system is important because it means that the product is:

	Very little (1)	2	3	4	5	6	Very much (7)
Healthier	<input type="radio"/>						
Safer	<input type="radio"/>						
More environment-friendly	<input type="radio"/>						
More animal-friendly	<input type="radio"/>						

Please indicate how much you agree with the following statements:

By using the shared decision-making system to buy animal based products

	Not at all (1)	2	3	4	5	6	Very much so (7)
I would feel a lot of uncertainty when making my decision	<input type="radio"/>						
I wouldn't feel any uncertainty while making my choice	<input type="radio"/>						

Please answer the following question

	Very uncertain	Uncertain	Somewhat uncertain	Neither uncertain or certain	Somewhat certain	Certain	Very certain
--	----------------	-----------	--------------------	------------------------------	------------------	---------	--------------

	certain						
When making a choice based on the shared decision-making system, would you feel very certain or very uncertain about the outcome?	<input type="radio"/>						

Please indicate how much you agree with the following statements:

By using the shared decision-making system to buy animal based products, I would feel

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
confident that I can access information about a product at any time to make an informed choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
that I know where to look to find information about a product that I don't know myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
that even if I don't know some information about a product right away, I know that I can access it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

By using the shared decision-making system to buy animal based products

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
it would be impossible to be certain about which product fits my preferences best	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would feel confident when identifying one product that best matches my preferences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would be convinced to find a product that best fulfils my needs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

The information provided in the chatbot was

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Easy to process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to understand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to comprehend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I believe that my interaction with this technology would be clear and understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
It would be easy for me to become skillful in using this technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find this technology easy to use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

In relation to animal based products

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using the app would improve my performance in evaluating the products during online shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find the app to be useful for online shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the app would enhance my effectiveness in online shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer the following questions:

	Not at all (1)	2	3	4	5	6	Very much (7)
How much do you think you could count on the shared decision-making system?	<input type="radio"/>						
How much do you think you would trust the shared decision-making system?	<input type="radio"/>						
How dependable do you think the shared decision-making system would be?	<input type="radio"/>						

Please indicate how much you agree with the following statement:

	Completely disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Completely agree
People, who are important to me, would think that I should use the SDM system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What is the importance of each of the following elements to trust the shared decision-making system?

Please rate the following elements:

	Very little (1)	2	3	4	5	6	Very much (7)
Reliable data ownership	<input type="radio"/>						
Transparency in data collection	<input type="radio"/>						
Possibility to visit farms	<input type="radio"/>						
Certification by Animal Protection Association	<input type="radio"/>						
Compliance controls and monitoring by Government (or Animal Protection Association)	<input type="radio"/>						
Blockchain technology data validation and security	<input type="radio"/>						

What else do you consider important?

What is the importance of the different components of the shared decision-making approach?

Please rate the following elements:

	Very little (1)	2	3	4	5	6	Very much (7)
Setting your own preferences and getting suggestions for the suitable products	<input type="radio"/>						
Possibility to interact with actors along the production chain (for example farmers)	<input type="radio"/>						
Verifiable data	<input type="radio"/>						
Usability of the technology (for example via app)	<input type="radio"/>						
Novelty	<input type="radio"/>						
Time saving	<input type="radio"/>						

What else do you consider important?

General questions

Please answer the following questions:

	Not at all good (1)	2	3	4	5	6	Very good (7)
How would you rate your knowledge of farming practices?	<input type="radio"/>						
How confident do you feel in choosing animal based products?	<input type="radio"/>						

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Free range farming and conventional farming are not particularly different	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
In conventional farming animals can stay outdoors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Free range farming allows animals to express more natural behaviour	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
In conventional farming newly born animals grow up with their mother	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Free range farming allows animals to have more and enriched space	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The majority of farm animals are reared (brought up) in free range farming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer the following question:

	Not at all familiar (1)	2	3	4	5	6	Extremely familiar (7)
How familiar are you with animal welfare standards?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer the following question:

	Not at all clear (1)	2	3	4	5	6	Extremely clear (7)
How clear of an idea do you have about which animal welfare standards are important for providing you with maximum satisfaction when you choose animal based products?	<input type="radio"/>						

Please answer the following question:

	Very little (1)	2	3	4	5	6	A lot (7)
How much do you know about animal welfare standards?	<input type="radio"/>						

Please answer the following question:

	One of the least knowledgeable (1)	2	3	4	5	6	One of the most knowledgeable (7)
How would you rate your knowledge about animal welfare standards relative to the rest of the population?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
It is morally wrong to hunt wild animals just for sport	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not think that there is anything wrong with using animals in medical research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think it is perfectly acceptable for cattle and hogs to be raised for human consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The slaughter of whales and dolphins should be immediately stopped even if it means some people will be put out of work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I sometimes get upset when I see wild animals in cages at zoos	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
It is important to me that the products I use do not harm the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider the potential environmental impact of my actions when making many of my decisions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My purchase habits are affected by my concern for our environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am concerned about wasting the resources of our planet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would describe myself as environmentally responsible	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am willing to be inconvenienced in order to take actions that are more environmentally friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What is your age?

0 10 20 30 40 50 60 70 80 90 100

Please move the slider to indicate your age.

What is your gender?

- Female
- Male
- Diverse

Please indicate your education level.

- PhD or higher
- Master (HBO, WO)
- Bachelor (HBO, WO)
- MBO (Dutch only)
- Secondary school
- Primary school
- None

Please select your monthly net household income (the sum of incomes of all household members):

- Below 1300 €
- 1300 - 2600 €
- 2601-3600 €
- 3601-5000 €
- Above 5000 €
- I prefer not to say

Are you currently...

- Employed
- Unemployed
- In training
- In education

Are you from a European or a non-European country?

- Non-European country
- European country

Please indicate your country of origin:

Please indicate your country of residence:

How many members are there in your household?

	0	2	4	6	8	10	12	14	16	18	20
Click to write Choice 1											

Are you in charge of the household's shopping?

- Mainly yes
- Mainly no

Do you have children?

- Yes
- No

Please answer the following question

0 10

How many children do you have?

Do you consider yourself:

- Omnivore (meat eating)
- Flexitarian
- Vegetarian
- Vegan
- Different (indicate below)

In case you selected "Different" please indicate what you consider yourself to be:

Do you usually consider animal welfare in your real purchasing decisions?

- Always
- Sometimes
- Rarely
- Never
- I prefer not to say

Thank you for participating in the survey! You can contact us at lorenza.bianchi@wur.nl for any questions.

Do you have any comments? For example on how information related to animal welfare could be provided to consumers? Or on the type of technology that could be used?

If you want to participate in the lottery to win a voucher, please write your e-mail address here.

Intro & static label: dairy

Thank you very much for your willingness to participate in this survey.

The aim of this survey is to explore your preferences on farm animal welfare and the role of technology in a shopping environment.

The survey will takes approximately 15 to 20 minutes of your valuable time. A prize will be raffled among all participants, so by completing the survey you will have the chance to win a voucher to spend online. To participate, please register your email at the end of the survey!

If you like to acquire more information about this study, please do not hesitate to contact us after completing the

survey.

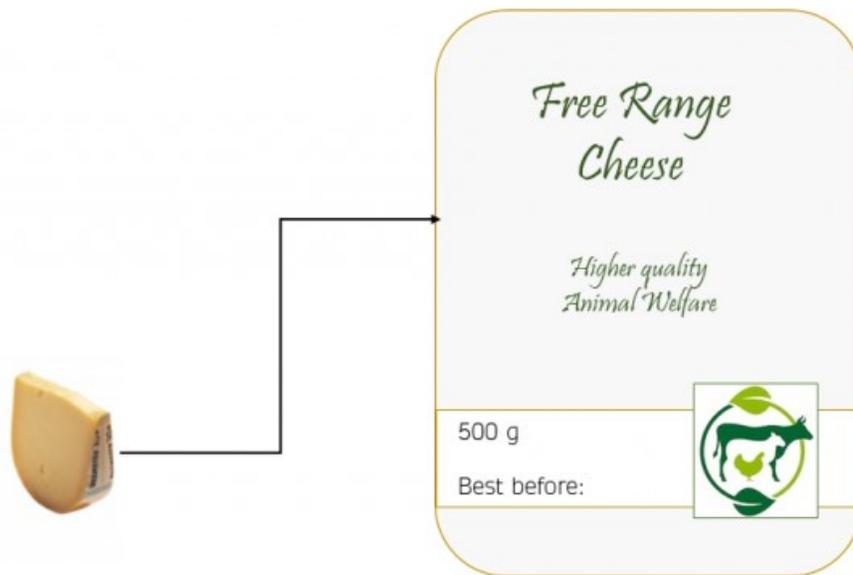
Note: The survey is also suited to be completed on a phone. However, if you have the chance to fill it in on a computer, please do so. The information collected will be treated in compliance with the privacy law and will be used only for scientific purposes.

Imagine yourself in a shopping environment. You would like to buy cheese for you and your family. Whilst scanning the cheese products, you recognise that there are products with an animal welfare label. The label is approved and guaranteed by the Animal Protection Association of your country.

The label contains the following information and refers to the following farming standards:

- Calves spend at least 5 months with their mother
- In the stable, each animal has a space of 6.6 m² and a shelter with straw
- Animals have access to outdoor grazing for 6 months per year

If you wanted, you could find additional information on the label's website.



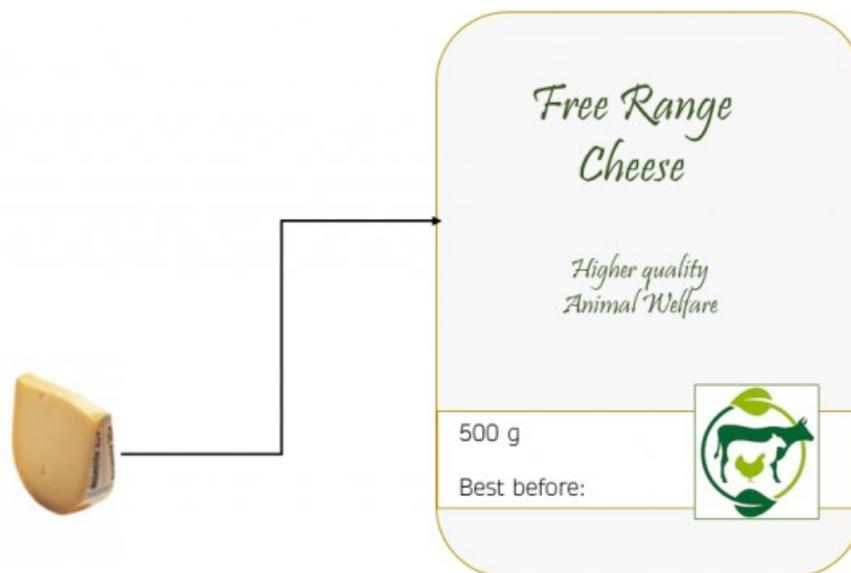
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Why would you buy the labelled product with respect to a corresponding product without the label?

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I consider this product healthier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider this product safer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider this product more environment-friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider this product more animal-friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would consider the label to be decisive for my purchase decision	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

Related to animal based products with the label

	Not at all (1)	2	3	4	5	6	Very much so (7)
I would feel a lot of uncertainty when making my decision	<input type="radio"/>						
I wouldn't feel any uncertainty while making my choice	<input type="radio"/>						

Please answer the following question:

	Very uncertain	Uncertain	Somewhat uncertain	Neither uncertain nor certain	Somewhat certain	Certain	Very certain
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Very uncertain	Uncertain	Somewhat uncertain	Neither uncertain nor certain	Somewhat certain	Certain	Very certain
When making a choice based on the label, would you feel very certain or very uncertain about the outcome?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The presence of the label makes me feel confident that I can access information about a product at any time to make an informed choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The presence of the label allows me to find information about a product that I don't know myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The presence of the label makes me feel that even if I don't know some information about a product right away, I know that I can access it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer the following questions:

	Not at all (1)	2	3	4	5	6	Very much (7)
How much do you think you could count on the label?	<input type="radio"/>						
How much do you think you would trust the label?	<input type="radio"/>						
How dependable do you think the label would be?	<input type="radio"/>						

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I believe that my interaction with this label is clear and understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy for me to use this label	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find this label easy to use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

In relation to animal based products

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using the label improves my performance in evaluating the products during shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find the label to be useful for shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using the label enhances my effectiveness in shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

The information provided on the label was:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Easy to process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to understand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to comprehend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would choose to buy animal based products with the support of the label to have more guarantees on animal welfare in farming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I normally use the information provided to choose animal based products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I normally rely on my gut feelings when I choose animal based products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statement:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I normally spend much time reading labels during my shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Introduction technology-based label (dairy)

Introduction of a technology-based interactive label

Recent technological developments have made it possible to collect very specific information on the welfare of farm animals. For instance, instead of an overall score for a brand, a single piece of meat or cheese can now receive a unique set of scores based on a lot of different welfare criteria.

We can imagine that you do not have the time to consider all this information when you go shopping. A solution for this may be that you use an app to set your preferences regarding animal welfare once. Then, the app helps you by finding the products that fit your welfare preferences.

We present an innovative labelling approach that is able to do this and more: the shared decision-making system. The following summary gives an overview of what the shared decision-making system can offer to you:

- You can obtain information on animal welfare, based on data that is collected continuously through non-invasive sensors at every step of the process from the farm to your plate (for example, on farm, during transportation, etc.).
- You can register your preferences on animal welfare in the system and get support for your purchasing decisions. For example: You wish that the animals have the opportunity to graze outside; if you register this preference in the system (through an app) it will help you to find products that guarantee that the animals have spent time outside their stable grazing on pasture, which are suitable for you and your indicated preferences and requirements.
- If you do not want to set your own preferences, you may also make use of criteria set by organisations committed to animal protection (for example the Animal Protection Association of your country). Subsequently, products are shown that comply with these criteria (as in the previous example). This is particularly useful if you think that you don't know enough about animal welfare standards, or simply don't have enough time to set your personal preferences.
- Through technological instruments like a chatbot, you may interact with actors in the supply chain. This way, you can ask for clarity and additional information.

Shortly describe the shared decision-making system as a support to shopping decisions in your own words

What do you think of the shared decision-making system as a support to shopping decisions related to animal based products?

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Please answer the following question.

A shared decision-making system is a:

- Management platform
- Platform to inform consumers
- Marketing strategy
- Online shopping platform

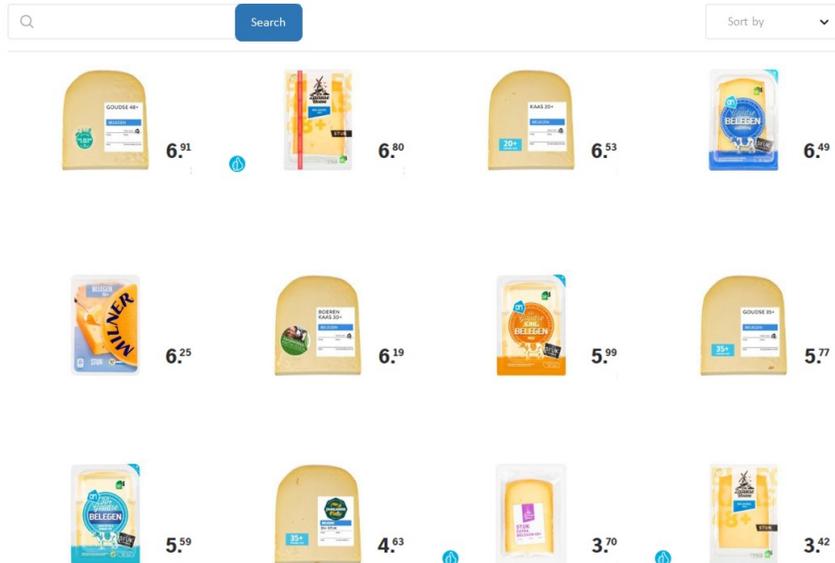
Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would like to use this system when choosing an animal based product	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I very much like the idea of such a system because it would help me find the appropriate products fitting my preferences on animal welfare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

You would like to buy cheese for you and your family. Imagine yourself in an online shopping environment where all options are available (have a look at the example below).

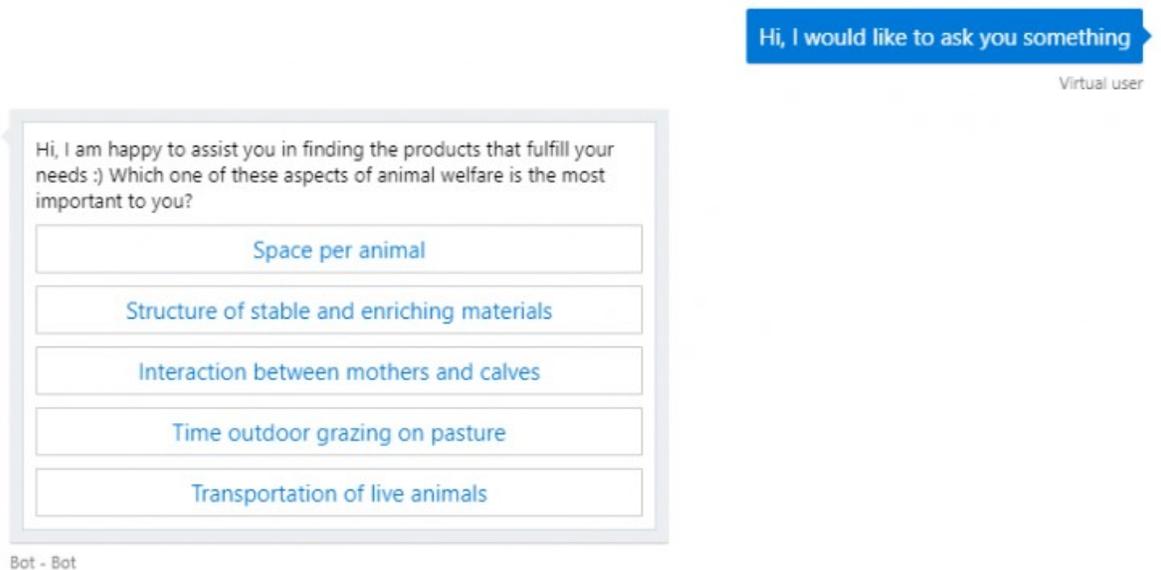
In a shared decision-making system, you could select animal welfare criteria and base your shopping decisions on them.

On the next screen, you can try this out with the help of a chatbot.



Chatbot dairy

Please choose one of the five options and click on it to answer the chatbot.



You chose "space per animal". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

The screenshot displays a chatbot interface with two messages from a 'Virtual user' and two responses from the 'Bot'. The first message from the user asks for assistance in finding products based on animal welfare needs. The bot provides five options: 'Space per animal', 'Structure of stable and enriching materials', 'Interaction between mothers and calves', 'Time outdoor grazing on pasture', and 'Transportation of live animals'. The second message from the user selects 'Space per animal'. The bot responds by offering to show products with at least 6.6 m2 of space available in the stable and provides a 'Show me the products' button.

Virtual user

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Virtual user

Space per animal

Virtual user

I can show you products from animals that each have at least 6.6 m2 of space available in the stable. Would you like to see them?

Show me the products

Bot - Bot

You chose "structure of stable and enriching materials". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

- Space per animal
- Structure of stable and enriching materials
- Interaction between mothers and calves
- Time outdoor grazing on pasture
- Transportation of live animals

Bot - Bot

Structure of stable and enriching materials

Virtual user

I can show you products from animals that have stables enriched with straw and soft materials. Would you like to see them?

- Show me the products

Bot - Bot

You chose "interaction between mother and calves". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Hi, I would like to ask you something

Virtual user

I can show you products from animals from which the calves have spend a minimum of 5 months with their mothers. Would you like to see them?

Show me the products

Bot - Bot

Interaction between mothers and calves

Virtual user

You chose "time outdoor grazing on pasture". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

The screenshot displays a chatbot interface with two main sections. The top section shows a user message in a blue bubble: "Hi, I would like to ask you something" and the bot's response in a light blue box: "Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?". Below the text are five buttons: "Space per animal", "Structure of stable and enriching materials", "Interaction between mothers and calves", "Time outdoor grazing on pasture", and "Transportation of live animals". The bottom section shows a user message in a blue bubble: "Time outdoor grazing on pasture" and the bot's response in a light blue box: "I can show you products from animals that were free to graze outdoors 6 months per year, 12 hours a day. Would you like to see them?". Below the text is one button: "Show me the products".

Virtual user

Hi, I would like to ask you something

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Time outdoor grazing on pasture

I can show you products from animals that were free to graze outdoors 6 months per year, 12 hours a day. Would you like to see them?

Show me the products

Bot - Bot

You chose "transportation of live animals". The chatbot can show a list of products from different shops nearby, that fit the aspect that you chose. Answer the chatbot to see the product list.

Hi, I would like to ask you something

Virtual user

Hi, I am happy to assist you in finding the products that fulfill your needs :) Which one of these aspects of animal welfare is the most important to you?

Space per animal

Structure of stable and enriching materials

Interaction between mothers and calves

Time outdoor grazing on pasture

Transportation of live animals

Bot - Bot

Transportation of live animals

Virtual user

I can show you products from animals that have been transported for no more than 8 hours. Would you like to see them?

Show me the products

Bot - Bot

Questions after chatbot (dairy)

These five products are from different shops, but all meet the requirement that you have selected.

Note that this is just an example: in a real life shared decision-making system you will be able to ask every question you wish.

Search

Sort by ▼



4.75



7.32



6.32



6.49



8.69

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would ask questions through the chatbot if I had doubts on the farming practices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would register my preferences on animal welfare to get only suitable products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would choose to buy animal based products with the support of the shared decision-making system to have more guarantees on animal welfare in farming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The chatbot based shared decision-making approach would be very useful for my decision making related to animal based products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the presence of the shared decision-making system, I would switch to more animal friendly products because I would have a guarantee on the animal welfare standards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please rate the importance of the following elements.

The fact that animal welfare standards are guaranteed by the shared decision-making system is important because it means that the product is:

	Very little (1)	2	3	4	5	6	Very much (7)
Healthier	<input type="radio"/>						
Safer	<input type="radio"/>						
More environment-friendly	<input type="radio"/>						
More animal-friendly	<input type="radio"/>						

Please indicate how much you agree with the following statements:

By using the shared decision-making system to buy animal based products

	Not at all (1)	2	3	4	5	6	Very much so (7)
I would feel a lot of uncertainty when making my decision	<input type="radio"/>						
I wouldn't feel any uncertainty while making my choice	<input type="radio"/>						

Please answer the following question:

	Very uncertain	Uncertain	Somewhat uncertain	Neither uncertain nor certain	Somewhat certain	Certain	Very certain
When making a choice based on the shared decision-making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Very uncertain	Uncertain	Somewhat uncertain	Neither uncertain nor certain	Somewhat certain	Certain	Very certain
system, would you feel very certain or very uncertain about the outcome?							

Please indicate how much you agree with the following statements:

By using the shared decision-making system to buy animal based products, I would feel

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
confident that I can access information about a product at any time to make an informed choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
that I know where to look to find information about a product that I don't know myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
that even if I don't know some information about a product right away, I know that I can access it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

By using the shared decision-making system to buy animal based products

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
it would be impossible to be certain about which product fits my preferences best	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would feel confident when identifying one product that best matches my preferences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would be convinced to find a product that best fulfils my needs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

The information provided in the chatbot was

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Easy to process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to understand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy to comprehend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I believe that my interaction with this technology would be clear and understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
It would be easy for me to become skillful in using this technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find this technology easy to use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate how much you agree with the following statements:

In relation to animal based products

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Using the app would improve my performance in evaluating the products during online shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find the app to be useful for online shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the app would enhance my effectiveness in online shopping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please answer the following questions:

	Very little (1)	2	3	4	5	6	Very much (7)
How much do you think you could count on the shared decision-making system?	<input type="radio"/>						
How much do you think you would trust the shared decision-making system?	<input type="radio"/>						
How dependable do you think the shared decision-making system would be?	<input type="radio"/>						

Please indicate how much you agree with the following statements:

	Completely disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Completely agree
People, who are important to me, would think that I should use the SDM system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What is the importance of each of the following elements to trust the shared decision-making system?

Please rate the following elements:

	Very little (1)	2	3	4	5	6	Very much (7)
Reliable data ownership	<input type="radio"/>						
Transparency in data collection	<input type="radio"/>						
Possibility to visit farms	<input type="radio"/>						
Certification by Animal Protection Association	<input type="radio"/>						
Compliance controls and monitoring by Government (or Animal Protection Association)	<input type="radio"/>						
Blockchain technology data validation and security	<input type="radio"/>						

What else do you consider important?

What is the importance of the different components of the shared decision-making approach?

Please rate the following elements:

	Very little (1)	2	3	4	5	6	Very much (7)
Setting your own preferences and getting suggestions for the suitable products	<input type="radio"/>						
Possibility to interact with actors along the production chain (for example farmers)	<input type="radio"/>						
Verifiable data	<input type="radio"/>						
Usability of the technology (for example via app)	<input type="radio"/>						
Novelty	<input type="radio"/>						
Time saving	<input type="radio"/>						

What else do you consider important?