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Modified Atmosphere Packaging (MAP) on the Rise: A Conjoint Analysis of MAP's Effect on Consumer Behavior in US, UK, French and German Markets

Simen Svendsen Railo and Vegar Veseth Saue

Supervisor: Professor Yuko Onozaka

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Modified Atmosphere Packaging (MAP) on the Rise:
A Conjoint Analysis of MAP's Effect on Consumer Behavior in US, UK, French and German Markets

AUTHOR(S)		SUPERVISOR:
Candidate number:	Name:	Yuko Onozaka
5057	Simen Svendsen Railo	
5090	Vegar Veseth Saue	

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Foreword

This study was conducted as a final project for our Master of Science in Business Administration with a specialization in Economics at the University of Stavanger Business School. Writing this thesis has been a challenging task, but at the same time it provided us with the opportunity to learn a great deal about econometric analysis and academic work methods. We would like to thank our supervisor Professor Yuko Onozaka for excellent guidance and honest feedback throughout the process.

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Simen Svendsen Railo

Vegar Veseth Saue

Abstract

Modified Atmosphere Packaging (MAP) is a food packaging technology that sees widespread use in an array of fresh food products, due to its positive effect on shelf-life and quality, and as a measure to reduce food spoilage. In this study we utilize data collected using discrete choice experiments in a Belief-Preference model framework to study consumer perceptions of MAP by separately accounting for beliefs and preferences. The models we applied allowed us to examine how consumers perceive the quality of products packed using MAP, and how trade-offs between price and quality affect product choice. We applied the models to data from the US, UK, French and German markets, and our results show that there is variation in consumer preferences between countries, as well as variations in how MAP is perceived. We find US consumers to have a more negative view on MAP than European consumers. The use of MAP caused diminishing quality for the perceived freshness, taste, food safety and healthiness in the US, and diminishing quality for the perceived freshness and healthiness in Germany. An important finding in our study is that the consumers' perception of MAP is constructed of not just a perception of the technology on its own, but also by where the products are sold, and the longer expiration dates. Products sold on the shelves, all else being equal, provides a convenience premium over products sold over the counter, however, this premium is dominated by a penalty stemming from a reduction in the perceived quality in the other quality dimensions (freshness, taste, food safety and healthiness), causing the total effect to be negative. This finding is further supported by our part-worth decomposition of consumers' willingness-to-pay (WTP) for MAP, where we find that the WTP consists of more than just a perception of convenience, but of overall product quality.

1. Introduction

In today's market environment, consumers are increasingly demanding and discriminating in the search for safer and healthier products of good quality (Parry, 1993). This is forcing the food industry to develop new technologies to meet their consumers' increasing demands. The success, or failure, of these new technologies depends almost entirely on whether consumers accept or reject them (MacFie, 2007).

Modified Atmosphere Packaging (MAP) is one answer to consumers increasing demands with its positive effect on shelf-life and product quality, and as a measure to reduce food spoilage. The technological effects of MAP have been extensively studied, but there have been few studies on its impact on consumer preferences and willingness-to-pay (WTP) (Grebitus, Jensen, Roosen, & Sebranek, 2013). This study investigates how MAP is perceived by consumers and how it affects consumer preferences. We apply the Belief-Preference Model framework[1] presented by Costanigro and Onozaka (2018), which is a model aimed at better explaining the heterogenous preferences found in consumers. We will apply this model to produce parameter estimates for consumers' perception of MAP in five quality dimensions (taste, freshness, food safety, convenience and healthiness), and then combine those parameters with estimates for consumer perceptions of MAP according to a set of quality cues (expiration dates, shelf vs. counter display and price). Enabling the investigation of consumers quality perceptions and how trade-offs between price and quality affect product choice.

With this study we will provide valuable information about MAP and its effect on consumer behavior, as well as revealing possible differences between the countries. In addition, our study is one of few to decompose consumers' WTP for MAP, which allows us to examine how consumer perceptions of MAP depends on their reaction to longer expiration dates, to where it is sold, and to the perceived qualities of MAP.

[1] The Belief-Preference model framework will be explained in the conceptual framework section (Chapter 3).

2. Literature Review

2.1. Consumer Responses to New Food Technologies

Consumers' willingness to accept a new food technology relies heavily on three key determinants: perceived risk, perceived benefit and perceived naturalness (Siegrist, 2008). In this section we will discuss how perceptions of these three determinants affect consumer acceptance of new food technologies.

The first key determinant we discuss is the perceived risk associated with new food technologies. Consumers perceive this risk to be greater if the consequences of the new technology are thought to be unidentified (at least to a degree) by scientific experts (Slovic, 1987), and new technologies are typically perceived to be more risky than traditional and well established technologies (Siegrist, 2008). As expected, the perceived risk of a technology is negatively correlated with WTP (Siegrist, Cousin, Kastenholz, & Wiek, 2007). The second key determinant is the perceived benefit of a technology. Studies suggest that if a new food technology adds additional benefits to the product, it increases the probability for consumers to accept the technology (Lähteenmäki et al., 2002). That is, it must be perceived as beneficial for the consumers, giving them a higher value, and not only adding value for the producers and the industry (Siegrist, 2008), which implies that the technology itself is of less importance if it is perceived to be highly beneficial. A close link exists between perceived risk and perceived benefit in the sense that consumers expect to receive compensation for taking risks. In the case where the perceived benefits do not adequately compensate for the perceived risk, consumers will not accept the technology (ex. nuclear power after the Three Mile Island incident). The final key determinant is perceived naturalness, and products perceived as natural are often considered safer due to a higher degree of consumer confidence in natural foods. This in turn implies that a technology viewed as unnatural will struggle to gain the acceptance of consumers, at least to a higher degree than those perceived as natural (Tenbült, de Vries, Dreezens, & Martijn, 2005). The perceived naturalness of food can therefore be used to explain consumers' preference for certain food technologies and apparent distaste for others (Ronteltap, Van Trijp, Renes, & Frewer, 2007).

An effective measure in gaining consumer acceptance for a new food technology is information because consumers need information to be able to correctly assess the true risks and benefits

associated with a technology. For example, consider a technology perceived by consumers to increase risk, but where the true risk associated with the technology is nonexistent or minuscule. In this case, the gap between perception and reality presents a problem as it inclines consumers to reject the technology on false grounds. A lack of information can therefore be a significant obstacle in gaining acceptance for the technology in the eyes of the consumer (Cardello, Schutz, & Lesher, 2007; Rollin, Kennedy, & Wills, 2011). However, providing consumers with more information is not a simple task as the new information can be ignored, misinterpreted, and in some cases increase confusion and consumer concerns (Grunert, 2005). In addition to the more general issues with providing information discussed above, there is the problem of information having psychological effects on consumers. Studies have suggested that informing consumers about the manufacturing process may have an influence on their perceived taste (Caporale & Monteleone, 2004). In these kinds of cases, providing consumers with information may have a negative effect on their willingness to accept new food technologies.

Consumers' reactions to new information may also be influenced by their prior beliefs about the technology (Rollin et al., 2011). For example, a large percentage of consumers show an aversion to chemicals, and, in some cases, believe that all chemicals are bad. If a technology involves the use of chemicals, some consumers may not believe it to be safe regardless of information received (see Chemophobia). This means that information contradicting prior beliefs may be ignored by consumers, because they use new information to confirm their current beliefs, rather than correct them (B. R. McFadden & Lusk, 2015). This, in turn, implies that information alone is insufficient in gaining acceptance for a new food technology, and that it is conditional on the information being trusted by the consumer (Siegrist, 2008; Verbeke, 2006).

2.2. Modified Atmosphere Packaging

Modified atmosphere packaging (MAP) is a technology used to increase shelf-life and quality and to reduce spoilage in fresh foods. The method consists of substituting the air inside the packaging with a single gas, or a mixture of protective gases. Most producers use a combination of two or three gases depending on the needs of the specific product (Sivertsvik, Rosnes, & Bergslien, 2002). The most common is a combination of oxygen (O_2), carbon dioxide (CO_2) and nitrogen (N_2) (Grebitus, Jensen, & Roosen, 2013; Sivertsvik, Rosnes, et al., 2002). There have been some concerns about the possibility of MAP masking food spoilage. Brooks et al. (2008) investigated spoilage and safety characteristics of ground beef packed using MAP.

They concluded that the use of MAP does not mask spoilage, nor increase pathogen contamination. In fact, MAP lowers pathogen contamination compared with traditional packaging (Brooks et al., 2008). Amanatidou et al. (2000) found that MAP packaging with a high O_2 concentration helps muscle foods retain their color, and that this, in combination with its positive effect on shelf-life, has led to widespread use of the technology. A side effect from a high concentration of O_2, is that it accelerates the oxidation process resulting in steaks having significantly lower tenderness and juiciness (Kim, Huff-Lonergan, Sebranek, & Lonergan, 2010). In a study on Scandinavian consumers, it was found that they preferred steaks without oxygen in terms of WTP, eating quality, liking, tenderness, juiciness and flavor (Aaslyng, Tørngren, & Madsen, 2010).

The use of MAP in the packaging of salmon does not affect the color retention as N_2 is used to replace O_2, in order to prevent rancidity (Sivertsvik, Jeksrud, & Rosnes, 2002). The color is nevertheless important as consumers perceive redder fillets as fresher, better in flavor, higher quality and higher value (Anderson, 2001). The redness is obtained by feeding them carotenoids (a type of pigment) found in wild salmon (Anderson, 2001), giving the salmon fillets the red color that the consumers want. For chicken, Martínez Michel, Anders, and Wismer (2011), found that color is not the most dominant determinant. Production method, convenience in food preparation and which part of the chicken the meat is from, are the most important attributes for consumers. Attributes of less importance are processing method, flavor and storage method.

There have been few studies on MAP's effect on consumer choices and WTP, and even fewer studies decomposing consumers WTP. Costanigro and Onozaka (2018) investigated how MAP affects consumer preferences in the US. They found that products sold over the counter are perceived to be tastier, fresher, healthier and safer. Whereas prepacked on the shelf is perceived as more convenient. US consumers were on average willing to pay $1.06 more for products sold over the counter and 8 cents per day for longer expiration dates. Informing the consumers about the use of MAP caused, holding expiration dates constant, diminishing quality in all dimensions except for convenience, and lowered WTP by an average of $1.18 (Costanigro & Onozaka, 2018). In contrast, Grebitus, Jensen, and Roosen (2013) found that the use of MAP increased WTP for US consumers, however, for German consumers WTP decreased when they were informed about the MAP technology. In another study they found that longer shelf-life was preferred after information about MAP was provided, but the use of CO-MAP (the use of carbon monoxide in MAP to stabilize color) weakened the trust in MAP. They concluded that

if the information on MAP is not understood by the consumers, they may perceive the product as more risky which leads to a lower WTP (Grebitus, Jensen, Roosen, et al., 2013).

2.3. Policies Regarding New Food Technologies – US and EU

When comparing food policies between US, UK, France and Germany, we will compare food policies between the US and the European Union (EU), due to how EU regulations are enforced in member countries.[2] Historically, the EU and the US have had different food cultures. Governments and consumers in the EU have been less risk averse towards traditional foods such as cheese and raw milk. The US on the other hand, has been more positive towards new food technologies (Echols, 1998; Jordan, 2005). Both the US and the EU have well established food policies, but these differ in some areas. In the EU, the food policy is based on the precautionary principle (PP), meaning that the policy is risk based, with a strict risk evaluation (EU, 1997; Keenan, Spice, Cole, & Banfi, 2015). Historically, the US has employed a control system based on a "reasonable certainty of no harm", where the risk assessments, for the most part, were done by private companies (Keenan et al., 2015). Today, the US employs the HACCP (Hazard Analysis and Critical Control Point) approach, which is a preventative system of quality control (Pierson, 1992). The risk based use of HACCP approach was introduced by the signing of the FSMA (Food Safety Modernization Act) in 2011 (Keenan et al., 2015). This approach enables the FDA (Food and Drug Administration) to be more proactive, and focus on preventing food safety issues rather than reacting after the fact (FDA, 2011). This means that the US is approaching a precautionary policy similar to that of the EU, though, there are still differences between them. This becomes clear when we compare food policies for novel foods. In the US there are minimal regulations, though the producers must ensure that the foods are safe and that they are in compliance with legal requirements. However, the EU, with its strict regulations, is one of the most challenging markets in the world for novel foods (Keenan et al., 2015). Overall, when comparing food policies in US and Europe, one cannot say that one is more precautionary than the other (Jordan, 2005; Wiener & Rogers, 2002). For example, the EU exhibits greater precaution than the US in using food technology such as hormones in feed and GMO (genetically modified organisms), and the US is more protective about, for example, mad cow disease in beef (Keenan et al., 2015; Wiener & Rogers, 2002).

[2] Note that the UK regulations referenced, may be subject to change following the UK's exit from the EU.

2.4. Policies Regarding MAP – EU and US

The use of MAP in the US and the EU is regulated differently, but at their core they are both regulated through concepts concerning food-contact materials (Heckman, 2005). In the EU, all materials should be explicitly based on toxicological evaluation of the substances that are listed in the regulations (Restuccia et al., 2010). The US approach is more informal, where substances that are not likely to cause any health problems, or not expected to become components of food, are cleared (Restuccia et al., 2010). The EU requires products packed using MAP to be labelled with the phrase "Packed in a protective atmosphere" (EU Regulation, 2011), informing the consumers of the food technology used in the products packaging. In the US, however, it is not required that the use of MAP is labelled because MAP is generally recognized as safe (GRAS) (Grebitus, Jensen, & Roosen, 2013).

MAP containing carbon monoxide (CO-MAP) is widely used to stabilize color. In the US, CO-MAP is, like MAP, recognized as safe (GRAS), and labelling the use of CO (carbon monoxide) in MAP is not mandatory (Grebitus, Jensen, & Roosen, 2013). In the EU, the European Commission Health & Consumer Protection Directorate concluded that there are no health concerns associated with the use of CO in MAP, but pointed out that the presence of CO may mask spoilage (EC, 2001). In 2004 the European commission prohibited the use of CO-MAP (Preedy, 2014), thus MAP containing CO cannot be used in the EU (Grebitus, Jensen, & Roosen, 2013). In short there are clearly differences in the policies employed, the US being more positive towards new food technologies, while the EU is more skeptical, both in food policy decisions using PP, as well as the consumers being more risk averse (Rollin et al., 2011).

2.5. Estimation of Preferences

When measuring willingness to pay (WTP), we are essentially talking about the consumer's perception of the quality of the product. The consumer will only complete a purchase if the perceived quality and safety of the food is high enough that the consumer is willing to pay the price demanded at the store. This relationship between perceived quality and price is often referred to as *value for money* (Grunert, 2005). Many studies estimating WTP for product attributes fail to control for consumer beliefs (Costanigro, Deselnicu, & Kroll, 2015). This error stems from a failure to acknowledge the fact that WTP is composed of a combination of preferences *and* beliefs. These preferences and beliefs are subjective probabilities and failing to distinguish between them can lead to misinterpretation of the results.

One therefore needs data on beliefs, as well as preferences, to understand consumer choices (Lusk, Schroeder, & Tonsor, 2013). Manski (2004) proposed a solution by asking consumers the perceived probability for a certain attribute (e.g. MAP) leading to a certain outcome (e.g. buy). However, it has been viewed as controversial to ask consumers about their perceived probability, due to how humans internally represent their belief probabilities (Manski, 2004). It is also difficult to translate product choices involving quality perceptions into probabilistic estimates (Costanigro & Onozaka, 2018). A solution is to use a Likert scale, a scale that is simple to construct, easily understandable and is likely to produce reliable results. Despite having many advantages it is essentially qualitative, difficult to validate, and exposed to framing effects (Costanigro & Onozaka, 2018; Page-Bucci, 2003). By using standard discrete choice experiments (DCE) one can prevent many of the issues mentioned. DCEs allow for separately identifying beliefs and preferences by creating richer data, resulting in a model that allows the researcher to investigate consumers WTP in terms of both beliefs and preferences (Costanigro & Onozaka, 2018).

2.6. Discrete Choice Models

The model applied in this study is a discrete choice model (DCM). Discrete choice models were first made practical by D. McFadden (1974) by his introduction of the random utility framework and the conditional logit model. McFadden showed how a sample of people faced with a discrete choice problem, combined with assumptions on the distribution of preferences for the population, could facilitate the estimation of a probabilistic choice model (Manski, 2004).

Discrete choice models are used to analyze changes in behavior following changes in the attributes of a good. For this purpose, standard consumer theory is inadequate. Lancaster (1966) illustrated this by an example of a choice between a red and a gray Chevrolet, which in standard consumer theory are either the same, which ignores the color, or they are different goods. The idea behind DCMs is to attempt to explain the different choices people make in the real world, many of which would be written off as irrational according to standard utility theory. An important concept in DCMs is that it is the attributes of a good, and not the good itself, that determine the utility a consumer gains from consuming it (Lancaster, 1966). There are also several assumptions behind DCMs, several of which it shares with standard utility theory. As in standard utility theory, decision-makers are assumed to be rational, utility maximizing individuals with stable preferences. I.e. when faced with a choice between different bundles,

decision makers can identify the most preferred option based on the level of utility gained from obtaining it, and then choose said bundle (Mandy, Gerard, & Amaya-Amaya, 2008).

The difference between DCMs and standard utility theory lies with the utility. In DCMs the utility gained is not revealed by choice, only rankings of alternatives which are scale invariant may be observed, and it is assumed that the individual choice behavior is random (random utility) (Train, 2009). A defining characteristic of DCMs is the fact that the dependent variable follows a discrete distribution, meaning they may take on a finite number of mutually exclusive values (Train, 2009). DCMs can further be divided into two groups. In the first group we find binomial choice models, where the dependent variable takes a binary form (i.e. 0 or 1). The second group, called multinomial choice models, are models where the dependent variable may take any number of values 0, 1, 2, …, k, $k < \infty$, (Ben-Akiva, Lerman, & Lerman, 1985).

3. Conceptual Framework

The following sections will cover the conceptual framework for the Belief-Preference model as presented by Costanigro and Onozaka (2018). At the base of the model is the view that consumers measure the utility gained by consuming a good by the intrinsic qualities of the good, and not by the good itself (Lancaster, 1966). In addition, the utility gained is, by default, a result of an assessment of multiple qualities (Costanigro & Onozaka, 2018; Parasuraman, Zeithaml, & Berry, 1985; Zeithaml, 1988). If we assume that product *j* possesses certain levels of quality represented by the Q-dimensional vector of quality levels $Q_j' = \left(Q_j^1, Q_j^2, \dots, Q_j^Q\right)$, then, an individual *i* who consumes a unit of the product will gain a level of utility given by $U_{ij} = U_i\left(Q_j, Price_j; \gamma_i\right)$, where $Price_j$ is the price paid and γ_i is a vector meant to represent how each individual consumer weighs product qualities.

There are many real-life scenarios in which the true nature, or value, of a quality (or qualities) is unobserved and unmeasurable at the time of purchase. Examples of these kinds of qualities could be experience qualities such as taste presented by Nelson (1970), or credence qualities like environmental friendliness (Darby & Karni, 1973). In the case where the true value of a quality is unobserved, consumers will have to rely on the perceived or expected qualities of the

good to assess the level of utility gained from consuming it. In the following, these perceived qualities are indicated as Q_{ij}, which highlights the inherent subjectivism of perceptions. Following the above, the utility gained from consumer *i* consuming a product, *j,* featuring unobservable qualities, is: $U_{ij} = U_{ij}(Q_{ij}^1, Q_{ij}^2, \dots, Q_{ij}^Q, Price_j; \gamma_i)$.

In the models that are to follow, we assume that consumers utilize the observable quality cues to evaluate the true quality state of a product. This means that consumers base their perception of the quality of a good on cues like, for example, smell and color (intrinsic), and labels or brand names (extrinsic). If we are in a situation where there are *K* quality cues for a product *j* presented to consumers, and included in a vector $X_{ij}{}' = (X_{i1}, X_{i2}, \dots, X_{iK})$, it follows that, for each of the quality dimensions q, the perceived quality is $Q_{ij}^q = Q(X_{ij}; \beta_i^q)$. The perceived quality is explained in terms of market cues (given by X_{ij}) and $\beta_i^{q\prime} = \left(\beta_{i1}^q, \beta_{i2}^q, \dots, \beta_{iK}^q\right)$, which is a vector of subjective belief parameters linking market cues with the quality dimensions, i.e. for a market cue *k*, a belief parameter exists for consumer *i* for all q quality dimensions: $\beta_{ik}^q = \beta_{ik}^1, \beta_{ik}^2, \dots, \beta_{ik}^q$.

Heterogeneity in consumer perceptions of quality may stem from individuals being exposed to varying quality cues, however, it may also be caused by differing interpretations of (or ways to interpret) what a specific quality cue signifies. For example, if a consumer believes that genetically modified foods are less healthy and less safe than conventional food products, then, it follows that the quality cue associated with genetically modified foods will have a negative belief parameter in the healthiness and food safety dimensions. The belief-formation process is not modeled in this paper, and we assume beliefs to be static (or at least given by a point in time, i.e. time of survey). This assumption is quite reasonable, at least as long as the survey does not itself influence consumer beliefs.

In section 2.1 we discussed consumer responses to new food technologies in terms of the perceived risk, perceived benefit and perceived naturalness of the technology, and how the perception of each of these determinants affect their willingness to accept the technology. We also discussed how informing consumers about a technology is, in most cases, a good strategy in gaining their acceptance. So far in our conceptual framework we have discussed how consumers measure the level of utility gained from consuming a good, and how this process is based on a perception of multiple qualities of a product. These qualities are closely related to

how the product is perceived in terms of risk, benefit and naturalness. I.e. perceived benefit may consist of a sum of several perceived qualities (e.g. freshness, taste, healthiness, environmental friendliness), and it is these perceived qualities we aim to estimate and interpret in this study. More specifically we would like to estimate and interpret how the technology MAP is perceived in a number of quality dimensions, and how this affects product choice. To this end we formulated the following hypotheses:

Hypothesis 1: Informing consumers about the use of MAP will have a positive effect on the perceived convenience of the product.
Hypothesis 2: Informing consumers about the use of MAP will have a positive effect on the perceived overall quality of the product.

The first hypothesis is based on the idea that because the use of MAP increases shelf-life, the products should be perceived to be more convenient because the period in which it can be safely consumed is extended, and time of use is therefore more flexible. Hypothesis 2 is more of a general representation of how MAP, as a technology with positive effects, should increase the perceived overall quality of products where it is used. We do, however, realize that this second hypothesis is unlikely to be proven true, as new and unproven technologies often are perceived to be more risky than old and well established ones (Kahneman & Tversky, 1979; Slovic, 1987). Subsequently, this increased risk would negatively impact consumers' valuation of the technology and the valuation of the product. The experimental design detailed in Chapter 4 was devised to measure how consumers perceive MAP in a number of quality dimensions, and applying the models presented in the following sections to the data gathered allowed us to test our hypotheses.

3.1. The Reduced Form Model

The reduced form specification of the Belief-Preference model is a basic model where consumer heterogeneity is assumed to be contained in the stochastic error term η_{ij}, and the estimated parameters, δ, consist of both beliefs and preferences (β and γ respectively). Under the assumption that consumers face identical prices for identical products, the typical specification of choice models in this setting is:

$$U_{ij} = U\left(X_{ij}, Price_j; \delta\right) = X'_{ij}\delta_1 + \delta_{price}Price_j + \eta_{ij} \quad (1)$$

Equation 1 yields the utility gained by an individual *i* choosing product *j*, and, in a situation where an individual *i* is faced with a choice between product A and product B, this yields the probabilistic statement:

$$\Pr(U_{iA} > U_{iB}) = \Pr((X_{iA} - X_{iB})'\delta_1 + \delta_{Price}(Price_A - Price_B) > \eta_{iB} - \eta_{iA}) \quad (2)$$

Equation 2 shows how consumers compare different products based on the available market cues and prices. In this Reduced Form model specification, WTP is calculated by $WTP_k = \frac{\delta_k}{-\delta_{Price}}$, where the parameter for a quality cue is divided by the negative of the price parameter.

3.2. The Belief-Preference Model

The Belief-Preference model recovers belief and preference parameters in a two-part process. The first part consists of a quality sorting task where participants are asked to compare a set of products and associated quality cues (shelf vs counter display, eat before dates and MAP), and then select the product they perceive to be superior in a number of quality dimensions (freshness, taste, food safety, convenience and healthiness). In the second part, the participants indicated which product they would purchase (if any at all) based on the prices and quality cues presented. The model enables us to use the results from the first part to estimate beliefs about qualities of products, and the results from the second part to recover preferences (implied by products chosen). This can be illustrated by a case where consumers are asked which of the two products A and B are superior in the quality dimension q, and quality perceptions in terms of market cues and beliefs shown in equation 3:

$$Q_{ij}^q = Q\left(X_{ij}; \beta^q\right) + \varepsilon_{ij}^q = X'_{ij}\beta^q + \varepsilon_{ij}^q \quad (3)$$

In equation 3 above, the β^q is an average of a constant vector of beliefs in the consumer population, ε_{ij} is a random error term. The probability that product A is perceived to be superior to product B in a given quality dimension can be written as: $\Pr\left(Q_{iA}^q > Q_{iB}^q\right) = \Pr\left((X_{iA} - X_{iB})'\beta^q > \varepsilon_{iB}^q - \varepsilon_{iA}^q\right)$, where the probability is given as a function of market cues

and a vector of average beliefs. After establishing quality perceptions, a model of how certain consumer preferences lead to certain product choices can be expressed as:

$$U_{ij} = U\big(Q_{ij}, Price; \gamma\big) + v_{ij} = Q'_{ij}\gamma_1 + \gamma_{Price} Price_j + v_{ij} \quad (4)$$

In equation 4, γ1 is a vector consisting of the marginal utility of each quality, γ_{Price} is the marginal utility of money, and v_{ij} is a random error term. Then, given that a purchase is to take place, the probability of choosing product A over B can be written as:

$$\Pr(U_{iA} > U_{iB}) = \Pr\left((Q_{iA} - Q_{iB})'\gamma_1 + \gamma_{Price}(Price_A - Price_B) > v_{iB} - v_{iA}\right) \quad (5)$$

Which, to put it simply, shows the task of comparing two products based on price vs. quality tradeoffs.

In the Belief-Preference model we decompose WTP for the various quality cues via the perceived qualities, and the part-worth decomposition of WTP for quality cue X_k is:

$$WTP_k = \frac{\gamma_1 \beta_k^1}{(-\gamma_{Price})} + \frac{\gamma_2 \beta_k^2}{(-\gamma_{Price})} + \cdots + \frac{\gamma_Q \beta_k^Q}{(-\gamma_{Price})} \quad (6)$$

4. Experimental Design

This study is based on data collected from survey interviews with a total of 8,623 respondents in four countries (US, UK, France and Germany). The survey was designed by Costanigro and Onozaka (2018), and it collected data on frequency of consumption of both chicken and salmon. It also collected data on consumer responses to the positioning and presentation of salmon and chicken products in the four countries by means of choice experiments. The survey was administered to representative samples of the population in each of the four countries, in terms of age, gender and geographic location. In addition to the product related questions, respondents were asked to provide information on children in the household, combined household income, their age, gender and social status. The main portion of the survey revolved around choice

experiments, however, before starting the choice experiments, respondents were asked to complete a short psychometric test to assess how important food-related decisions were to them. Specifically, the Food Involvement Scale developed by Bell and Marshall (2003). The food involvement scores are discussed further in our results section, and they are presented in Table 3 with means and standard deviations.

The choice experiments compared chicken to salmon by asking participants to compare boneless skinless chicken breasts and salmon fillets. This was done because both cuts are readily available in US, UK, French and German grocery stores, as well as them being very similar in terms of usage. In the survey, three quality cues (K=3) were chosen, in addition to product type. The three cues were display (shelf vs. counter), eat before date (3, 7 and 14 days) and MAP. Display and eat before date cues were chosen due to them being the most prominent among the quality cues typically observed in a grocery store setting, and MAP was chosen to reveal how MAP affects consumer choices. The display cue is meant to model the choice between purchasing a product on the shelves, which might be considered more convenient, and purchasing products over the counter by interacting with shop staff. Purchasing products over the counter provides consumers with the opportunity to select both product and product sizes and may also give consumers the opportunity to receive information about the preparation and cooking of the product, which may influence the perception of quality.

The choice experiment part of the survey collected data along five quality dimensions (Q = 5): freshness, taste, food safety, convenience and healthiness, and was divided into two parts. The first part was a quality sorting task, where the participants were asked to state which of the products presented they found superior (chicken or salmon) in each of the five quality dimensions. The second part consisted of a product choice task, which involved the participants stating which product they would choose, based on the quality cues[3] and price. The choice experiments were divided into 18 choice sets (tasks), which stem from the three quality cues used to explain the choice sets: display (shelf vs counter), eat before date (3, 7 and 14 days) and three levels of prices, and the sum of possible combinations of attributes amounts to 18. Each of the choice sets included one chicken and one salmon product described by varying quality cues, and, in addition, they were described using imagery.

[3] Refers to the attributes of the products presented in each choice situation: days before expiration, shelf or counter display and MAP packaging.

To ease the workload for participants, a subset of six choice tasks was assigned to each. A partitioning strategy was employed to ensure a sequential release of information, meaning participants would be faced with the quality cues first, and then prices. The method consisted of identifying six blocks of three choice sets each. In each of the six blocks, the three choice sets were as similar as possible in terms of quality cue levels. For example, in one block the expiration dates were the same for salmon in each of the three sets, and the other quality cues as similar as possible. Participants were given a randomly drawn question from each block, which generated 27 (3 x 3 x 3) unique surveys of six choice tasks each. This ensured that participants wouldn't be assigned two choice tasks differing only in price, and consequently made it impossible for any participant to repeat the same choice set during the quality sorting task. The choice tasks were constructed to be as similar to real shopping scenarios as possible. This was achieved by imposing constraints during the translation of the design into choice tasks. Specifically, eat before dates were only revealed for products sold on the shelves, and not for products sold over the counter, which is representative of how expiration dates are presented in real life situations.[4]

In the experimental design, all products labeled with a 14-day expiration date were packed using MAP, however, not all participants were informed of this fact. MAP's effect on quality perceptions was identified by randomly assigning participants in the experiments to either a control group or a treatment group, and the participants in the control group received no information about MAP, or its use in the products. In the treatment group the participants were provided with a simple science-based explanation of MAP packaging and its effects on the products[5], and all products sold on the shelf with a 14-day expiration date were presented with the MAP label to reflect the fact that MAP is almost exclusively sold on the shelf. Lastly, price levels were made to be product specific (i.e. salmon is generally more expensive than chicken, and this was reflected in the price levels in the survey) representative of existing market

[4] For products sold over the counter it is uncommon to provide an expiration date as the expectation is that the product is to be consumed in a relatively short amount of time (in the survey they were labeled "fresh from the counter").

[5] The provided information to the treatment group was: When the "Eat Before Date" is very long, such as 14 days, it is because the product is packed with a special technology. One such technology is called Modified Atmosphere Packaging (MAP). In MAP, the package is sealed with special mixtures of gases instead of normal air. This packaging substantially slows down the process of food spoilage so that products can stay fresh longer. A product labeled MAP is also labeled with the statement "Packed with a protective atmosphere" below the eat before date.

differences (between chicken and salmon) and were given in three levels: low, medium and high.[6]

5. Empirical Models

In our empirical study we estimated two models. The first model is a reduced form model where beliefs and preferences are not separately accounted for. The estimated parameters from this simpler model allowed us to calculate WTPs for the quality cues (expiration dates, shelf vs. counter display and MAP), but it provided no clues as to what lies beneath the surface of these WTPs. The second model we estimate is the Belief-Preference model presented by Costanigro and Onozaka (2018). In the Belief-Preference Model we separately account for beliefs and preferences, which allows us to examine consumer perceptions about MAP in two ways. Firstly, we are able to examine how the quality cues affect the expectations consumers have about product quality in the quality dimensions (taste, freshness, food safety, convenience and healthiness). Secondly, this allows us to examine how trade-offs between price and quality affect product choice. In the next few parts we will present our empirical models, and, as in the conceptual framework section, β is used to represent beliefs, γ represents preference, and δ represents both preference and beliefs before they are separately accounted for (reduced form). In the model specifications we follow the specification from Costanigro and Onozaka (2018).

5.1. The Reduced Form Model

In the Reduced Form model (equation 1 in Chapter 3), parameters were estimated using product choice data alone, which in practice entailed regressing the product choice by the quality cues, price, product (chicken or salmon) and an option for opting out (no buy). Below is the parameterization of the utility gained by an individual *i* choosing either chicken or salmon:

$$U_{ij} = U(U_{ij}, P_j; \delta) = \delta_0 Chicken_{ij} + \delta_1 Shelf_{ij} + \delta_2 Dates_{ij} + \delta_3 MAP_{ij} + \delta_4 Price_j + \eta_{ij} \qquad (7)$$

[6] The medium price was based on market data from the Norwegian Seafood Council and Kantar Worldpanel. The low and high price levels were, respectively, -25% and +25% from the medium.

In equation 7 above, the variable $Chicken$ is an indicator for product types, i.e. 1 for chicken or 0 for salmon (δ_0 is the associated alternative-specific constant), $Shelf$ is the indicator for shelf vs. counter, $Dates$ are the number of days before expiration (eat-before date), and MAP (14 days eat-before date x MAP information treatment) indicates whether or not the participant was informed about the use of MAP. $Price$ is the price indicator in USD.[7] The respondents also had the option to opt out and select "no purchase", which would yield a utility of $U_{ij} = \delta_5 + \eta_{ij}$.

If we imagine a situation in which an individual i face J choices and with an assumption that the error term is Type I Extreme Value (D. McFadden, 1978), the probability of said individual choosing product j takes the binomial logit form:

$$Pr_{ij} = \frac{\exp(X'_{ij}, \delta)}{1 + \exp(X'_{ij,}\delta)} \tag{8}$$

Estimations from the Reduced Form model are presented in Table 4. Estimating parameters for the quality cues and their associated WTP based on this model gave us a good indication of how MAP affects consumer choices. However, we are unable to observe how the perceived qualities of the product influence the consumers' WTPs for the quality cues. This is because the estimated parameters only show perceptions about the quality cues, without taking into consideration the quality dimensions (beliefs) that influence the formation of consumer perceptions.

5.2. The Belief-Preference Model

After estimating the Reduced Form model, we began estimating the Belief-Preference model (from equations 3 and 4) where beliefs and preferences are separately accounted for, which allowed us to estimate how the perceptions of the quality cues were constructed through the quality dimensions. The perceived quality was made to be a function of product cues[8] for all dimensions, specified as:

[7] Prices in the survey were presented in local currency, i.e. USD for US respondents, GBP for UK respondents, and Euros for French and German respondents.

[8] The alternative-specific constant for product types is included in the specification in equation 9, even though it is not a quality cue. This is done in case there are differences in perceived qualities between the products that are not explained by the quality cues included in the experimental design.

$$Q_{ij}^{q} = X_{ij}'\beta^{q} + \varepsilon_{ij}^{q} = \beta_0^{q} Chicken_{ij} + \beta_1^{q} Shelf_{ij} + \beta_2^{q} Date_{ij} + \beta_3^{q} MAP_{ij} + \varepsilon_{ij}^{q}; for\ q = 1 \ldots,5 \quad (9)$$

We stacked the data relative to the five quality dimensions (freshness, taste, food safety, convenience and healthiness) for each participant, and the five parameter vectors were estimated jointly using multinomial logit to yield one vector of estimates for each of the quality dimensions. The estimation results are shown in Table 5. After estimating the parameter vectors for the quality dimensions, the estimates were used to predict perceived quality, $\hat{Q}_{ij}^{q}$, which we then used as regressors in the product choice model.

At this point it should be noted that the model in equation 3 does not allow for belief heterogeneity. However, the experimental design randomized participants across 27 unique surveys, which caused some exogenous variation in the predicted perceived quality ($\hat{Q}_{ij}^{q}$). A problem we encountered with the perceived qualities was the high degrees of correlation between them (correlation matrixes shown in Table 1). This was a problem in the estimation of preference parameters, and in order to produce estimates a composite quality index, $\bar{\hat{Q}}_{ij}^{q}$, was constructed by averaging the positively correlated perceived qualities (freshness, taste, food safety and healthiness). The parameter for convenience was negatively correlated with the other parameters and was left as a separate independent variable.[9] This led us to the following parameterization:

$$U_{ij} = \gamma_0 Chicken + \gamma_1 \bar{\hat{Q}}_{ij} + \gamma_2 \widehat{Convenience}_{ij} + \gamma_3 Price_j + v_{ij} \quad (10)$$

In the above parameterization, U_{ij} represents the utility gained by individual *i* selecting product *j*. The above specification was estimated using an alternative-specific conditional logit model (McFadden's choice). We used the "Nobuy" option as the base alternative and calculated the results for each country separately. The estimated parameters are shown in Table 6. The part-worth WTP decomposition was calculated using the formula below, for each quality cue:

$$WTP_{\gamma} = -\frac{\gamma * \bar{\hat{Q}}_{ij}^{q}}{\gamma_{Price}}$$

[9] For French consumers, convenience was estimated to be positively correlated with the four other perceived qualities, however, in the interest of comparison, convenience was left as a separate independent variable. A model was estimated with all 5 quality dimensions averaged into a composite quality index, however, it did not produce more statistically significant results.

Where $\bar{\hat{Q}}_{ij}^{q}$ represents the composite quality index, and γ represents the corresponding parameter, i.e. γ_1 for the composite quality index, and γ_2 for convenience. In the case of convenience, which was left as a separate independent variable, $\bar{\hat{Q}}_{ij}^{q}$ was simply replaced by a single parameter estimate, for example, the parameter estimated for the relationship between convenience and dates. The use of a composite quality index made us unable to determine the fine trade-offs between the four perceived qualities included in the index. However, we were still able to examine the Quality vs. Convenience vs. Price heuristics that have been known to determine consumers' perception of product value (Costanigro & Onozaka, 2018; Zeithaml, 1988).

Table 1: Correlation Coefficients among Perceived Qualities

US

	Freshness	*Taste*	*Food Safety*	*Convenience*
Taste	0.9550			
Food Safety	0.9971	0.9601		
Convenience	-0.6010	-0.7974	-0.6266	
Healthiness	0.7157	0.8887	0.7389	-0.9567

FR

	Freshness	*Taste*	*Food Safety*	*Convenience*
Taste	0.9797			
Food Safety	0.9333	0.8502		
Convenience	0.9870	0.9446	0.9742	
Healthiness	0.9963	0.9919	0.9011	0.9709

UK

	Freshness	*Taste*	*Food Safety*	*Convenience*
Taste	0.9822			
Food Safety	0.9338	0.9447		
Convenience	-0.8476	-0.9308	-0.8713	
Healthiness	0.7954	0.8815	0.9097	-0.9477

DE

	Freshness	*Taste*	*Food Safety*	*Convenience*
Taste	0.9496			
Food Safety	0.9896	0.9694		
Convenience	-0.9625	-0.9966	-0.9741	
Healthiness	0.8692	0.9800	0.9051	-0.9653

6. Results

6.1. Sample Representativeness

The purpose of this study was to examine consumer responses to MAP packaged salmon in relation to the alternative chicken. As such, we excluded respondents who indicated that they do not consume both chicken and salmon from the estimations. Several respondents were also dropped from the set due to missing information in either demographic variables, variables indicating level of food involvement, or choice data. Our sample consists of 1,202 complete responses for the US data, 1,252 for the UK, 1,502 for France and 1,386 for Germany, as shown in Table 2.

Table 2: Sample Sizes

	US	**UK**	**France**	**Germany**
Survey Responses	2,093	2,238	2,162	2,130
Chicken and Salmon	1,419	1,560	1,869	1,705
Ratio*	0.68	0.70	0.86	0.80
Complete Responses**	1,202	1,252	1,502	1,386

* The ratio refers to the portion of survey respondents who consume both chicken and salmon.
** Complete Responses represents net sample size after dropping respondents with missing information.

Several demographic variables were generated based on the data from the survey. These were Age, Female, Kids, Married, College and Income. A Country variable was also generated for each respondent (1-4, where 1 = US, 2 = UK, 3 = France and 4 = Germany). These variables were generated to allow for meaningful interpretation of the data, which would otherwise not be possible due to the way some answers were reported (e.g. year born, and not age). The question regarding household income was constructed so that respondents answered which bracket they would fit in, for example, one possible answer was that a person's household income was somewhere between $20,000-$29,999. To be able to meaningfully analyze the levels of income for the respondents, these values were centered. If using the same example as above, the household income would be centered to $25,000. In addition to this, all income reported in Euros or Pounds Sterling were converted to US Dollars. The three levels of prices used in the product choice task were also converted to USD.[10]

[10] Currency conversion rates used: GBPUSD = 1.40376, EURUSD = 1.23185.

In this paragraph we will present our sample in terms of how representative it is compared to the populations in the four countries. The survey was administered to representative samples of the population, however, while reviewing the estimates for our demographic variables, there were some differences between estimates and census data in the four countries. The estimated means and associated standard deviation are shown in Table 3. The respondents in our sample are slightly older than the population average in the four countries, with the exception of Germany, where the respondents in the sample are slightly younger. It is unlikely that these differences are caused by the design of the survey as the respondents were asked about their birthdate/year, which should eliminate the possibilities for misinterpretation or confusion. Thus, the difference remains largely unexplained, however, it is only a slight difference, and it should not significantly impact our findings. For household income, the estimated mean household income for US consumers differs from the reported census data. This is likely caused, at least in part, by limitations in the survey where the upped bound of the household income question was set to $200,000, which might contain respondents whose household incomes are significantly larger. For example, the US mean household income reported by the US Census Bureau (2016) was $83,143 before taxes, which, compared to our estimated mean of $70,102, is quite large. Part of this difference can be explained by the upper bound used ($200,000 in our data, $250,000 in census data), though even when correcting for the difference in upper bounds a large part of the difference prevails. This might indicate that the sample for the US consumers is slightly skewered in favor of lower income individuals, or that our centering of the highest income bracket was too modest. For the UK, French and German consumers the difference between our estimated mean household income and census data is rather small. For gender, the percentage of female survey respondents is somewhat lower than we would expect from population data, except for the data on French consumers, where the estimated mean for our sample matches the mean for the population.[11] The percentage of married respondents in our sample is quite high when comparing it to census data. Percentages range from 60-66%, differing by quite a large percentage when compared to population means of roughly 44% for France (Statista, 2017), 51% for Germany (Statistisches Bundesamt, 2016), 47% for UK (Statista, 2011) and 52% for the US (Statista, 2017). However, our variable for Married also includes domestic partnerships, which may explain some of the difference for some countries.

[11] Female percentage of populations in the countries are between 50-51.5%, reported in census data.

There are large differences in levels of education between the countries in our sample, and the percentage of respondents who have attended college (or higher) is large. As far as the relative differences between the countries go, it does make sense for the US to be at the top, followed by the UK, then France and lastly Germany. However, this still leaves us with a sample consisting of respondents with significantly higher mean levels of education compared to population statistics in the four countries.

6.2. Descriptive Country Differences by Food Involvement Scores

Food involvement scores are presented in Table 3. We find UK consumers to have significantly lower food involvement (FIS) scores than consumers in the other countries. On average, French consumers have the highest FIS scores, marginally higher than that of US and German consumers. In the following paragraphs we will present food trends in the different countries to interpret the differences in FIS scores between countries.

In France, consumers prefer homecooked meals and the majority of the consumers make homecooked meals on a daily basis (Pettinger, Holdsworth, & Gerber, 2006). They are also more prepared to make time for cooking and prefer cooking from raw ingredients (Pettinger et al., 2006). In contrast, US consumers have decreased the consumption of homecooked meals and reduced time spent on food making since the 1960s, however, this trend has leveled off since the 1990s. They consume the majority of meals at home, although only half spend any time cooking at home on a given day (Smith, Ng, & Popkin, 2013). In Germany, especially for consumers in their 30s or older, the trend is to cook meals at home with a focus on the meals being healthy. By contrast, younger and more urban German consumers tend to prefer more convenient foods (International Markets Bureau, 2012).

For UK consumers, the estimated mean FIS scores suggest that they care less about making food themselves, and that their food related decisions are not that important compared to other daily decisions. This could be explained by UK consumers' use of ready meals, where the ready meal market is one of the biggest in the world (Sun, 2014), and UK consumers have the highest ready meal consumption rate in Europe (Jackson & Viehoff, 2016). There are several possible reasons for the popularity of ready meals in the UK. The most important quality for ready meals is convenience, though as we will discuss later, we do not find consumers in the UK to be more concerned with convenience than consumers in other countries. The convenience of ready

meals is a result of several qualities of such meals, they save time, there is no need for cooking skills and they are suitable when eating alone (Ahlgren, Gustafsson, & Hall, 2004). The main difference between the UK ready meal market and the ready meal markets in the other countries is that in the UK there is a range of options, from low-end at a very low cost, to high-end meals that resemble a home-cooked meal. In many other countries, ready meals are not considered especially affordable compared to cooking from scratch (Bevis, 2012). UK consumers' easy access to convenient and cheap ready meals is one possible explanation for their significantly lower food involvement scores.

Table 3: Sample Descriptive Statistics

		US		UK		FR		DE	
		Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
Demographic Characteristics	Age	44.114	(12.84)	44.999	(13.10)	43.901	(12.88)	44.946	(12.21)
	Household Income	70,102	(48,419)	52,829	(41,947)	41,861	(28,702)	54,499	(40,549)
	Female (0/1)	0.45	(0.50)	0.47	(0.50)	0.51	(0.50)	0.48	(0.50)
	Married (0/1)	0.60	(0.49)	0.60	(0.49)	0.66	(0.47)	0.61	(0.49)
	Attended College	0.832	(0.374)	0.756	(0.430)	0.643	(0.479)	0.487	(0.500)
	Kids in HH (0/1)	0.398	(0.490)	0.336	(0.472)	0.350	(0.477)	0.255	(0.436)
Food Involvement Scores (1=strongly disagree, 7=strongly agree)	I don't think much about food each day. (R) Note: (R) indicates reversed scale.	5.00	(1.76)	3.46	(1.93)	4.85	(1.75)	4.68	(1.73)
	Cooking or barbecuing is not much fun. (R)	5.37	(1.87)	3.20	(2.01)	5.48	(1.79)	5.60	(1.82)
	Talking about what I ate or am going to eat is something I like to do.	4.78	(1.63)	4.61	(1.64)	4.82	(1.65)	4.64	(1.67)
	Compared with other daily decisions. my food choices are not very important. (R)	4.87	(1.93)	3.54	(1.89)	4.91	(1.74)	4.93	(1.76)
	When I travel. one of the things I anticipate most is eating the food there.	5.40	(1.50)	5.16	(1.57)	5.25	(1.59)	5.69	(1.51)
	I do most or all of the clean up after eating.	5.46	(1.65)	5.38	(1.68)	5.84	(1.54)	5.52	(1.60)
	I enjoy cooking for others and myself.	5.40	(1.65)	5.19	(1.70)	5.15	(1.78)	5.02	(1.83)
	When I eat out. I don't think or talk much about how the food tastes. (R)	5.25	(1.81)	3.30	(2.07)	5.77	(1.57)	5.16	(1.71)
	I do not like to mix or chop food. (R)	4.99	(1.86)	3.18	(2.03)	4.95	(1.83)	4.67	(1.89)
	I do most or all of my own food shopping.	5.88	(1.50)	5.86	(1.56)	5.68	(1.64)	5.71	(1.53)
	I do not wash dishes or clean the table. (R)	5.79	(1.83)	2.15	(1.84)	5.97	(1.63)	6.13	(1.57)
	I care whether or not a table is nicely set. (R)	3.55	(1.82)	3.43	(1.68)	3.10	(1.55)	3.24	(1.80)
			N=1,202		N=1,252		N=1,502		N=1,386

6.3. The Reduced Form Model

The estimation results from the Reduced Form model are presented in Table 4. The price coefficient is negative for all countries, as one would expect, and statistically significant for US and Germany. For US consumers, all else equal, providing information about the use of MAP, lowers WTP by an average of $1.19. Products sold on the shelf also lowers WTP and they are on average willing to pay $1.22 more for products sold over the counter. US consumers have a positive valuation of longer expiration dates, which are valued at 9 cents per day. German consumers showed no statistically significant WTP for MAP, but they are on average willing to pay $5.28 more for products sold over the counter than on the shelf, and value longer expiration dates at 14 cents per day. Consumers in every country preferred products sold over the counter to those sold on the shelf, but the view on MAP varied between the countries, and UK and French consumers displayed a positive view of MAP.[12] When choosing between chicken or salmon, consumers in the UK, France and Germany display a preference for chicken.[13]

The estimated price parameter for UK and France was very small and not statistically significant, causing the calculated WTPs for Shelf, Dates and MAP to be unnaturally large. The confidence interval for these WTPs are therefore wide. The lack of statistically significant results could be explained by the research design, for example, it is possible that it did not manage to minimize noise effects, or that the sample was too small (though this is unlikely as a minimum of 1,200 respondents per country should be sufficient). It is also possible that the design did not manage to capture UK and French consumers' price attributes. As previously stated, the price consists of three levels: low, medium and high. Where the medium price is based on prices normally demanded for the products in each region, low is -25%, and high is +25%. If, for example, the medium price was set too high or too low, the consumer responses to the prices would not be able to correctly capture the consumers' price sensitivity, which in turn would lead to an inaccurate price estimate and insignificant results.

[12] In the Reduced Form Model, estimated price parameters were not statistically significant for UK and French consumers, and the MAP parameter was not statistically significant for German consumers.
[13] Estimated chicken parameter was not statistically significant for US consumers.

Table 4: Reduced Form Model Estimates

	US		**UK**		**FR**		**DE**	
	Coefficients	*Implied WTP*	*Coefficients*	*Implied WTP*	*Coefficients*	*Implied WTP*	*Coefficients*	*Implied WTP*
Shelf	-0.252***	-$1.22	-0.210***	-$27.91	-0.421***	-$41.96	-0.457***	-$5.28
	(0.035)	[-1.52 , -0.91]	(0.034)	[-106.48 , 50.66]	(0.031)	[-139.74 , 55.81]	(0.034)	[-6.69 , -3.85]
Dates	0.018***	$0.09	0.017***	$2.26	0.004	$0.42	0.012**	$0.14
	(0.006)	[0.04 , 0.14]	(0.006)	[-4.39 , 8.92]	(0.005)	[-0.95 , 1.81]	(0.005)	[0.03 , 0.24]
MAP	-0.247***	-$1.19	0.138*	$18.34	0.121*	$12.01	-0.033	-$0.39
	(0.087)	[-1.93 , -0.46]	(0.084)	[-34.74 , 71.41]	(0.073)	[-16.78 , 40.81]	(0.076)	[-1.83 , 1.06]
Price	-0.207***		-0.008		-0.010		-0.087***	
	(0.016)		(0.013)		(0.014)		(0.013)	
Nobuy	-2.632***		-1.208***		-1.646***		-1.795***	
	(0.152)		(0.134)		(0.144)		(0.127)	
Chicken ASC	0.034		0.988***		0.522***		0.121*	
	(0.065)		(0.069)		(0.063)		(0.062)	
	N=1,202		N=1,252		N=1,502		N=1,386	
	Number of observations= 21,537; Number of cases= 7,179; Number of individuals=1,202; Log-likelihood=-6,682.391.		Number of observations= 22,449; Number of cases= 7,483; Number of individuals=1,252; Log-likelihood=-6,115.531.		Number of observations= 26,946; Number of cases= 8,982; Number of individuals=1,502; Log-likelihood=-7,956.327.		Number of observations= 24,819; Number of cases= 8,273; Number of individuals=1,386; Log-likelihood=-8,110.573.	
	Robust standard error clustered by individual in parentheses. *p<0.10, ** p<0.05, *** p<0.01. 90% WTP CI in brackets							

6.4. The Belief-Preference Model

As shown in Table 5, products sold over the counter are perceived to be fresher, tastier, safer and healthier in all countries. Prepacked food on the shelf, on the other hand, is perceived to be more convenient in all countries except France, where products sold over the counter were perceived to be more convenient. Longer expiration dates improve the perception of product freshness and safety in the US, convenience in the UK, and freshness in Germany. For French consumers the longer expiration dates decreased the perceived freshness and healthiness of the product.

In the US, providing information about the use of MAP caused diminishing quality in all dimensions except for convenience. In Germany, it caused diminishing quality for freshness and healthiness. UK and French consumers are none-responsive to MAP in all quality dimensions. However, products packed using MAP technology are sold on the shelf and it extends shelf-life. Consumers' responses to its use consists therefore not only of the perception of the technology, but also of their reaction to where it is sold and to the longer expiration dates. While the model does not directly produce statistically significant estimates for the MAP parameter for these two countries, we are still able to interpret the consumers' reactions to MAP through the parameter estimates for shelf and dates. UK consumers perceive longer expiration dates and products on the shelf to be more convenient, indicating that MAP too would be perceived as more convenient.[14] French consumers perceive shelf and longer expiration dates to decrease freshness and healthiness, which in turn indicates that the use of MAP also would decrease their perception of the product in these quality dimensions.

There are also some product-specific effects where the perceived qualities of salmon and chicken are heterogenous between the countries. Salmon is perceived tastier and healthier in all countries, while chicken is perceived to be more convenient (except by French consumers). US consumers perceive chicken to be the freshest of the two products, while German and French consumers perceive salmon to be the freshest. There are also some differences as far as food safety is concerned. US and French consumers perceive chicken to be the safer alternative, while UK and German consumers perceive salmon to be the safest option.

[14] Given that MAP is sold on the shelves and leads to longer expiration dates.

Table 5: Estimated Beliefs, Aggregated Model

US

	Freshness	*Taste*	*Safety*	*Convenience*	*Healthiness*
Shelf	-1.242***	-0.682***	-0.634***	0.273***	-0.704***
	(0.053)	(0.046)	(0.053)	(0.050)	(0.052)
Dates	0.024***	0.007	0.019**	0.011	0.011
	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)
MAP	-0.466***	-0.325***	-0.247**	-0.130	-0.576***
	(0.107)	(0.097)	(0.112)	(0.104)	(0.107)
Chicken ASC	0.204***	-0.102**	0.075*	0.384***	-0.686***
	(0.043)	(0.052)	(0.046)	(0.052)	(0.057)

Number of observations= 40,756; Number of cases= 20,378; Number of individuals= 1,202;
Log-likelihood= -12,901.474. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

FR

	Freshness	*Taste*	*Safety*	*Convenience*	*Healthiness*
Shelf	-1.367***	-0.983***	-0.526***	-0.457***	-0.852***
	(0.049)	(0.045)	(0.050)	(0.046)	(0.051)
Dates	-0.014*	-0.001	0.001	0.004	-0.012*
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
MAP	0.119	0.005	0.103	0.005	0.116
	(0.103)	(0.094)	(0.100)	(0.094)	(0.102)
Chicken ASC	-0.103**	-0.306***	0.145***	0.033	-0.152***
	(0.040)	(0.045)	(0.040)	(0.045)	(0.049)

Number of observations= 47,214; Number of cases= 23,607; Number of individuals= 1,502;
Log-likelihood= -14,781.026. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

UK

	Freshness	*Taste*	*Safety*	*Convenience*	*Healthiness*
Shelf	-1.397***	-0.794***	-0.341***	0.330***	-0.887***
	(0.055)	(0.049)	(0.057)	(0.053)	(0.057)
Dates	0.011	-0.000	0.002	0.021***	0.008
	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)
MAP	-0.046	-0.144	0.156	0.128	-0.153
	(0.118)	(0.099)	(0.116)	(0.113)	(0.110)
Chicken ASC	-0.026	-0.171***	-0.116**	0.311***	-0.953***
	(0.041)	(0.056)	(0.047)	(0.052)	(0.063)

Number of observations= 37,948; Number of cases= 18,974; Number of individuals= 1,252;
Log-likelihood= -11,721.852. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

DE

	Freshness	*Taste*	*Safety*	*Convenience*	*Healthiness*
Shelf	-1.482***	-0.965***	-0.730***	0.390***	-1.131***
	(0.054)	(0.050)	(0.056)	(0.049)	(0.060)
Dates	0.016**	0.004	0.002	0.003	0.010
	(0.008)	(0.006)	(0.008)	(0.007)	(0.008)
MAP	-0.343***	-0.152	0.051	0.079	-0.221**
	(0.115)	(0.095)	(0.113)	(0.100)	(0.111)
Chicken ASC	-0.185***	-0.548***	-0.160***	0.201***	-1.099***
	(0.041)	(0.051)	(0.045)	(0.050)	(0.059)

Number of observations= 42,288; Number of cases= 21,114; Number of individuals= 1,386;
Log-likelihood= -12,532.718. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

6.5. Belief-Preference Model with Quality Index

The results from the estimation are shown in Table 6. Composite quality and convenience are both positive and significant for all countries except France. For US and Germany, the price coefficient is negative and significant.[15] The estimated parameters show that consumers are concerned with both quality and convenience. For US consumers, all other things being equal, products sold on the shelves yield a convenience premium of $\frac{(0.273\times0.611)}{0.205} = \$0.81$, but it also reduces the perceived freshness, taste, food safety and healthiness, causing a penalty of $\frac{\{[¼\ (-1.242-0.682-0.634-0.704)]\times0.486\}}{0.205} = -\$1.93$,[16] and the total effect is negative (-$1.12). For German consumers the convenience premium is $7.06, with a penalty of -$12.32, causing the total effect to be negative (-$5.26). The results show that for products sold on the shelf, the perceived increase in convenience fails to compensate for the perceived reduction in the other quality dimensions. Although our model showed no statistically significant WTP for extended shelf-life and MAP (except Composite Quality for MAP in the US), the part-worth decomposition shows that consumers' valuation for shelf, longer shelf-life and MAP consists of not just convenience, but of overall product quality. We find French and German consumers to be significantly more concerned about convenience than in the other countries, and German consumers are also the most concerned with overall product quality. Consumers in the UK, France and Germany, as in the Reduced Form model, display a clear preference for chicken.[17]

The estimated price parameter, as in the Reduced Form model, for UK and French consumers is very small and not statistically significant. This causes the calculated WTP for Shelf, Dates and MAP to be unnaturally large. This indicates that the research design might not have been able to accurately capture consumers' price attributes, or that it did not manage to minimize noise effects.

[15] French and German consumers showed no statistically significant WTP for Shelf.
[16] The ¼ scaling is due to the averaging in the Composite Quality index.
[17] The estimated chicken parameter was not statistically significant for US consumers.

Table 6: Estimated Preference Parameters, Aggregated Model

US

		Part-Worth WTP Decomposition		
	Coefficients	*Shelf*	*Date*	*MAP*
Composite Quality	0.486***	-$1.93	$0.03	-$0.96
	(0.112)			
Convenience	0.611**	$0.81	$0.04	-$0.39
	(0.312)			
Price	-0.205***			
	(0.016)			
No Buy	-0.655			
	(0.787)			
Chicken ASC	-0.135			
	(0.118)			

Number of observations= 21,537; Number of cases= 7,179; Number of individuals= 1,202; Log-likelihood= -6,683.010. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

FR

		Part-Worth WTP Decomposition		
	Coefficients	*Shelf*	*Date*	*MAP*
Composite Quality	-0.346	$47.07	$0.33	-$4.33
	(0.314)			
Convenience	1.620**	-$108.08	$0.88	$1.18
	(0.663)			
Price	-0.007			
	(0.014)			
No Buy	0.633			
	(0.658)			
Chicken ASC	0.443***			
	(0.080)			

Number of observations= 26,946; Number of cases= 8,982; Number of individuals= 1,502; Log-likelihood= -7,958.688. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

UK

		Part-Worth WTP Decomposition		
	Coefficients	*Shelf*	*Date*	*MAP*
Composite Quality	0.578***	-$70.88	$0.42	-$3.83
	(0.080)			
Convenience	0.846***	$40.06	$2.51	$15.54
	(0.144)			
Price	-0.007			
	(0.013)			
No Buy	1.352***			
	(0.426)			
Chicken ASC	0.910***			
	(0.070)			

Number of observations= 22,449; Number of cases= 7,483; Number of individuals= 1,252; Log-likelihood= -6,115.785. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

DE

		Part-Worth WTP Decomposition		
	Coefficients	*Shelf*	*Date*	*MAP*
Composite Quality	0.995***	-$12.32	$0.09	-$1.90
	(0.227)			
Convenience	1.574***	$7.06	$0.05	$1.44
	(0.583)			
Price	-0.087***			
	(0.013)			
No Buy	2.738*			
	(1.429)			
Chicken ASC	0.300***			
	(0.064)			

Number of observations= 24,819; Number of cases= 8,273; Number of individuals= 1,386; Log-likelihood= -8,110.577. Robust standard error clustered by individual in parentheses.
* p<0.10, ** p<0.05, *** p<0.01.

7. Discussion and Conclusions

The purpose of this study was to investigate how MAP is perceived by consumers in the US, UK, French and German markets. We examined consumer responses to MAP using data collected from survey interviews with a total of 8,623 respondents in the four countries, with 1,202 complete responses for the US data, 1,252 for the UK, 1,502 for France and 1,386 for Germany. Based on the survey data we estimated parameters for how consumers perceive MAP in several quality dimensions (freshness, taste, food safety, convenience and healthiness).

The estimation results show that consumer perceptions of MAP vary between countries. US consumers have a negative valuation of MAP, where informing the consumers about its use lowered WTP by an average of $1,19. Consumers in the European countries display a more positive view of MAP, though we did not manage to calculate statistically significant WTPs for MAP for any of the European countries. The difference in consumer preferences may be caused by a lack of information for the US consumers. In the US, MAP is generally recognized as safe, meaning that products packed using MAP do not carry a MAP label, as they are required to in EU countries. US consumers lack of information about MAP can make it difficult for them to assess the risks, benefits and naturalness of the technology, which in turn may lead to a negative valuation. While this lack of information makes it more difficult for consumers to assess the risks, benefits and naturalness of MAP, providing them with more information will not necessarily lead to a more positive view. Information contradicting consumers' prior beliefs will often be ignored, because consumers frequently use new information to confirm their beliefs, not to correct them (B. R. McFadden & Lusk, 2015). US consumers negative view on MAP could therefore be caused by not only a lack of information, but also by negative prior beliefs about the technology. Nevertheless, a lack of information seems to be one of the causes of these negative perceptions of MAP, and this is supported by the findings from Grebitus, Jensen, Roosen, et al. (2013), who found that US consumers were not willing to pay for extended shelf-life when they were not informed of the packaging technology. They found, in contrary to our results, US consumers to have a positive WTP for MAP after they were informed about the technology, but they did not separately account for MAP and the increase in shelf-life. We find longer expiration dates to have a positive effect and valued at 9 cents per day in the US and 14 cents per day in Germany.[18]

[18] No statistically significant WTP for dates was estimated for UK and French consumers.

The use of MAP increases shelf-life, quality and reduces food spoilage in fresh foods. We therefore hypothesized that products packed using MAP would have a positive effect on consumers' perceived overall quality of the product. However, the results disprove our hypothesis, as informing consumers about the use of MAP caused diminishing quality in all dimensions except for convenience in the US (see Table 5). For German consumers, it caused diminishing quality for freshness and healthiness. For UK and French consumers, the results are inconclusive, but consumer responses to the use of MAP may be given by the responses to the longer expiration dates and the shelf placement. We can, through the estimated parameters for shelf and dates, interpret their reaction to MAP. The results indicate that UK consumers perceive MAP as more convenient and for French consumers it diminishes the perceived freshness and healthiness. Applying the Belief-Preference model also gave us the opportunity to explain *why* people are willing to pay more, or less, for certain attributes. The part-worth decomposition suggests that MAP affects consumer preferences, not just through the valuation of convenience, but through the valuation of overall product quality (see Table 6). We find that prepacked food on the shelf is perceived to be more convenient[19] and that extended shelf-life is positive for both perceived convenience and overall product quality. This supports our hypothesis in that the use of MAP has a positive effect on the perceived convenience. However, in total, product sold on the shelves are perceived negatively,[20] because the increase in perceived convenience fails to compensate for the perceived reduction in the other quality dimensions.

Estimation results for consumer preferences in the choice between chicken or salmon[21], show that chicken is clearly preferred in the UK, France and Germany.[22] This is evident in both the Reduced Form model (Table 4) and in the Belief-Preference model (Table 6). Subsequently, when investigating how consumers perceive the products in the five quality dimensions (see Table 5), the estimates show that salmon is perceived to be healthier and tastier by consumers in all four countries, and chicken is perceived to be more convenient (except in France). The parameter for the perceived healthiness of salmon is positive and significant for all countries, as well as being relatively large for the US, UK and Germany. For French consumers the parameter is smaller (closer to 0), indicating that the difference in perceived healthiness

[19] French consumers did not perceive product sold on the shelf to be more convenient.
[20] Compared to products sold over the counter.
[21] Looking only at the choice between chicken and salmon.
[22] The estimated chicken parameter was not statistically significant for US consumers.

between chicken and salmon is considerably smaller. Overall the perceived qualities of chicken and salmon vary between the countries. US consumers perceive chicken to be fresher, while the opposite is the case for German and French consumers. In the US and France, consumers perceive chicken to be safer than salmon, whereas in the UK and Germany, salmon is perceived to be the safer option.

We acknowledge the fact that the models produced a low number of statistically significant parameter estimates for MAP and associated quality dimensions, and that we did not produce significant WTPs for MAP in the UK, France and Germany. However, we did produce statistically significant estimates for shelf display in all countries, and several statistically significant estimates for the parameter for expiration dates. Using these estimates, we were still able to make inferences as to how consumers perceive the quality of foods packed using MAP. Another problem we encountered was the high correlations[23] found between the perceived qualities, which we addressed by constructing a composite quality index, as previously explained in Chapter 5. This composite quality index made us able to run our estimations, but it made us unable to observe the finer trade-offs between quality dimensions.

Our findings have two important implications for the industry and producers. Firstly, we find that European consumers are more positive towards MAP than US consumers, which we suggest might be related to differing labeling policies between the US and the European countries. Our findings support previous research in that informing consumers about the technology is of great importance in gaining consumer acceptance (see; Cardello et al. (2007); Rollin et al. (2011); Caporale and Monteleone (2004); B. R. McFadden and Lusk (2015)). Secondly, our findings from the consumers' choice between chicken and salmon show that consumers in every country perceive chicken as more convenient, but salmon was preferred in most other quality dimensions (especially perceived healthiness and taste). The salmon industry and producers could therefore benefit from an effort to reduce the gap in the perceived convenience between chicken and salmon products.

The results from our study need to be validated, perhaps by replicating the study with a different sample, and further research is needed to more conclusively explain how MAP is perceived by consumers, and how information affects their perceptions. It could also be interesting to expand

[23] Correlations shown in Table 1.

the design to model heterogeneity in consumer beliefs to shed some light on how different consumer groups can interpret identical information in completely different ways. Another interesting topic for further research would be to investigate the perceived naturalness of MAP, which was not covered explicitly in the survey we based our study on. Perceived naturalness is generally very important for consumers when assessing the quality of a product. It could therefore be of value to investigate how the perceived naturalness of MAP affects, for example, consumers' perception of a products healthiness.

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