Avoiding Fraudulent Meat: Muslim Consumer Preferences for Halal Meat Products and Retailers

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1. Introduction

In the Muslim faith, halal means "lawful" or "permissible" for consumption, while non-halal products are *haram* or "forbidden" to be consumed. Practicing Muslims therefore are conscious of what foods they consume and look to halal certifications to guide purchases. However, their consumption choices are some of the most complex for any consumer group – there are over 20 recognized third-party halal certifiers in the U.S., with an estimated additional 200 recognized halal certifiers throughout the world (Zabihah 2021, Verify Halal 2022). Furthermore, the global Muslim population does not have a universally accepted and verified halal standard; each of these certifying bodies require different practices, depending on how strictly they interpret the religious laws surrounding halal. The variety of certifications can make selecting a product confusing for consumers.

Halal is a credence attribute – a product characteristic where the consumer cannot judge the quality even after he or she inspects, buys, and uses the product (Caswell 1998) – meaning it is among the easiest of characteristics for processors and retailers to counterfeit or misidentify. As the halal meat market has grown, the authenticity of the halal meat sold in supermarkets has also been questioned by some Muslims, who have reacted against the practice of stunning and the use of mechanical blades (in the case of poultry) allowed in the halal standards adopted by these economic actors. As Muslims living in non-Muslim majority countries have attempted to reinforce their identity, the consumption of 'authentic' halal products by Muslims has risen significantly in the refutation of anti-Islamic rhetoric (Labour Force Survey, 2009; Marranci, 2009).

This research is driven by Muslim consumers' concerns over halal food fraud scandals (FSNS 2020; Smith 2020; McElwee et al. 2017; U.S. Department of Justice 2015). There have been numerous halal meat food fraud scandals over the past decade that undermine the integrity

of halal meat products. For example, there was an Orange County lawsuit against a supermarket chain that falsely advertised generic meat as halal (Carpenter 2011), a Michigan lawsuit alleging McDonald's misrepresented chicken as halal (Sacirbey 2013, CBSNews 2013, Huff Post 2013), and perhaps the most well-publicized: the ISA-Midamar scandal in which $4.9 million worth of beef was falsely sold as halal (Cornfield 2015, The Guardian 2014, U.S. Department of Justice 2015). Indeed, halal foods are the 4th most likely food in the US to be fraudulent (FSNS 2020, Smith 2020).[1] The cost of food fraud to the global food industry is nearly $40 billion annually (FDA 2021). The economic motivation for halal meat food fraud is simple: certified or specialty meat products fetch a higher price (FDA 2021).

Considering these issues with transparency and fraud in the market, our research questions focus on assessing how Muslim halal consumers participate in the halal meat market. First, how do Muslim halal meat consumers decide where or from which retailer(s) to purchase their halal meat products to ensure they are receiving authentic products? Furthermore, how does the relationship a consumer has with their current retailer impact their halal meat purchasing decisions? That is, what role does an established trustworthy relationship play in consumers determining whether a retailer is providing authentic products? And finally, when making the choice of where to purchase products, how do consumers value the presence of third-party verified halal meat certifications - in addition to or in place of an established trustworthy relationship - as a method for determining the authenticity of a product? The answers to these questions will support meaningful efforts to improving the transparency of the US halal meat market for Muslim consumers.

[1] Food fraud is the intentional sale of food products that do not align with recognized standards for economic gain (FDA 2021). Types of food fraud include substituting a specialty product for a generic version, using unapproved additives, misrepresenting something, mislabeling or counterfeiting, or intentional contamination with substances harmful to private- or public- health (FDA 2021, FSNS 2020).

2. Background Literature

Outside of the halal meat market, there is movement in the greater US food system towards increased transparency and traceability in food production; see for example Asioli et. al (2017), Briggeman & Lusk (2011), and Yiridoe et. al (2005). Consumers increasingly express desires to know how their food is produced, where it comes from, and who is producing it. Additionally, in recent years, consumers have demanded more methods to self-assess the authenticity of the products they purchase. In response, government and non-government organizations have created a plethora of labels to differentiate product attributes and production standards, such as the USDA Organic label or the Fair-Trade certification. However, fraud and transparency issues persist, as unscrupulous suppliers may use a label or certification on their products that they do not actually have permission to use. In this scenario, additional traceability or verification strategies and technologies are necessary to avoid fraudulent practices. Examples of such strategies and technologies that are currently being used in segments of the US food system include RFID, blockchain technology, conventional paper trails, labels and certifications, and auditing schemes (Steier & Friedlander 2021). Additionally, some stores have detailed certifications posted, and food packages can have QR codes or other information that consumers can use to self-assess the authenticity of a product before purchasing.

While consumer demand for additional transparency can be seen throughout the food system, it is especially strong in the halal meat market. The need for additional verification strategies in the form of reputable certifications for halal meat has been documented in other countries, namely in Europe where Muslims are a minority population (e.g., Ahmed 2008, Meixner et al. 2018, Ruslan et. al 2018), though also in some Muslim-majority countries (e.g., Ireland &

Rajabzadeh 2011, Khan et. al 2019), where much of the meat available to consumers is imported from non-Muslim majority countries. Research has also been conducted to understand what Muslim halal meat consumers want out of these certifications or other verification strategies (e.g., Bonne & Verbeke 2007, Verbeke et. al 2013) and to learn what preferences they have for halal meat attributes (e.g., Bonne & Verbeke 2008, Bonne et. al 2008, Verbeke et. al 2013) and halal meat purchasing locations (e.g., Bonne & Verbeke 2007 & 2008, Bonne et. al 2008, Verbeke et. al 2013).

With the lack of transparency currently in the halal meat market, an alternative method that Muslim halal meat consumers use to determine authenticity of the halal meat products they consume is the relationship they have formed with retailers that inspires trust in halal meat products. This trust versus certification tradeoff has been exhibited in the case of direct agricultural markets, namely the local food movement and consumer buying behavior at farmers' markets (Giovannucci et al. 2010). Here, consumers rely on personal relationships with sellers to bolster their confidence in a product's quality and authenticity in the absence of third-party verified certifications; this sense of trust and social embeddedness is a major advantage of direct agricultural markets (Hinrichs 2000). Scholars argue that relational trust establishes enduring relationships between vendors and buyers (e.g., Feagan and Morris 2009, Carson et al. 2016). That is, interaction with food producers creates bonds that might enhance mutual learning and complements or even replaces formal quality assurance systems such as third-party verifications (e.g., Hinrichs et al. 2004, Carson et al. 2016, Moore 2006). For example, the main social benefit reported from the spread of local food systems in the UK is the increased trust and connectedness that can be developed between and within consumers and producer groups (Pretty 2001). This is due largely to the face-to-face nature of these interactions, which mediate authenticity and trust

(Marsden 2000); the role of the relationship between consumer and producer or supplier itself constructs value and meaning. In particular, consumers place more trust in the quality of the products that are locally sourced – especially in the case of farmers' markets – because they value knowing exactly who has produced the product, where it comes from (Ilbery 2006, Seyfang 2008), and feel they have a personal connection with producers even if they have not ever met them directly (Giovannucci et al. 2010, Kirwan 2006, Masson & Bubendorff 2022). Further, consumer interest in local food encourages the development of local shops that in turn may become focal points for valuable social networks in communities (Pearson et. al 2011) – a key factor that should be considered when studying Muslim communities demanding halal meat products.

A similar pattern of relationship-based behavioral effects, referred to as a "relational contract" - informal agreements sustained by the value of future relationships (Baker et. al 2002) - has been explored in the literature in the context of a wide variety of industries (e.g., Rosch & Ortega 2018, Ola & Menapace 2020a & 2020b, Gereffi 1999, Calzolari et. al 2021, Argyres et. al 2021, Macchiavello & Morjaria 2015). In relational contracting, buyers exhibit preferences for entering into contracts with different sellers that depend on past interactions and relationships in addition to quality attributes and prices. In general, these studies find that buyers prefer to enter into contracts with sellers with whom they have had a positive buying experience from in the past, even if more financially advantageous contracts may be available with other sellers – in particular, those with which the buyer has no established relationship. In this way, buyers use existing relationships to mitigate the risks associated with entering into contracts where the contract is not perfectly enforced by outside agents such as third-party or government enforcement. In the case of poor follow-through, the relationship is terminated and further contracting opportunities lost (Brown et. al 2004, Macleod 2007).

Translating this relational contracting framework into Muslim halal meat consumers' purchasing decision scenarios, we see that having an established positive or trustworthy relationship with a halal meat retailer likely increases the chance that a Muslim halal meat consumer repeatedly patronizes a store to purchase halal meat products. This behavior may occur regardless of the additional third-party verified certifications present. Further, if a Muslim halal meat consumer were to discover that the halal meat products they have been purchasing from a given retailer are not authentic, then the consumer – and likely much of the community they interact with – would cease to patronize the retailer. In this manner, the retailer has strong incentives to produce an authentic product and continue the relationship with the customer, thus ensuring self-enforcement of halal meat authenticity.

To our knowledge, no research on Muslim halal meat consumers' preferences for halal meat products, their views on the integrity of US halal meat market, or their perceived tradeoffs between trustworthy relationships and certification enforced by third parties exists. Our analysis aims to address this literature gap by investigating Muslim consumer perceptions of halal meat food fraud as well as whether and how they determine the trustworthiness of halal certified meat products. This research will contribute first to a better understanding of US Muslim halal meat consumers' preferences for and opinions of halal meat retailers, products, and certifications, none of which have been previously studied. In addition to developing a baseline understanding of Muslim halal meat consumers demand patterns and preferences, this information will be immediately useful for the US domestic halal meat processors, retailers, and certifiers. Potentially, this information will inform policies to increase Muslim consumer trust in the halal meat market through regulations. Finally, this research will support efforts to promote equitable access to

authentic halal meat products for Muslim consumers through exploring factors that increase trust in halal meat retailers and certifications nationwide.

3. Methods

The lack of academic research to understand Muslim halal meat consumer preferences in the US market requires a methodological approach that allows for feedback in the design through learning and exploratory research. Additionally, it is important to consider the unique religious and niche nature of this market when developing data collection methods. As such, we propose utilizing a mixed methods approach with qualitative and quantitative components.

The methods for this study are conducted in two main stages. The first stage involves conducting and analyzing interviews with US Muslim halal meat consumers to build a baseline understanding of their preferences and motivations. Once this foundational understanding of the market and consumers' behavior is established, it will be used to inform the additional quantitative data collection methods in stage 2. This approach allows for an interactive connection between these two methods.

The interactive nature of this mixed methodology is exhibited in two respects. First, in the earlier phase of this project, multiple US Muslim halal meat consumers were interviewed to gain an improved understanding of their beliefs about the importance of consuming halal meat, experiences finding authentic halal meat products for consumption, and concerns about halal meat food fraud. We used these conversations to inform the development of the quantitative research questions and the design of the survey data collection methods. From these interviews, we determined that the most appropriate questions to explore in relation to US Muslims' halal meat consumption decisions revolve around motivations for demanding certain types and quality levels

of halal meat, as well as how trust and personal relationships may impact purchasing decisions. This focus led us to decide that the quantitative data collection should utilize a hypothetical choice experiment to evaluate the tradeoff consumers face between trustworthy relationships (relational contracts) and certifications, as well as Likert-type scales to assess aspects of consumer trust, beliefs about the importance of consuming halal and halal meat attributes, attitudes towards certifications, and other factors that could influence retailer selection.

The data from the quantitative portion of this study will be analyzed and then any noteworthy, surprising, or particularly significant results will be highlighted and discussed in the context of information collected from the interviews. In this manner, the research will come full circle and incorporate these two classes of methodologies throughout the project. In all, by utilizing a mixed methods approach with active community engagement, we ensure current Muslim halal meat consumers' concerns and opinions are heard and incorporated into the study design so this study can address ongoing racial, ethnic, and religious inequities in the US food system.

3.1 Phase 1: Interview Methods

In total, 12 in-depth semi-structured interviews with Midwestern Muslim halal meat consumers were conducted in Summer 2022. Interviewees were recruited in-person between June 12th and June 29th, 2022; in-person recruitment was deemed necessary due to privacy concerns related to retailers sharing customer contact information with the researchers and the hesitancy that members of a religious minority community may face participating in academic research. Participants were recruited from five different halal meat retailers in Illinois, Michigan, and Wisconsin. These states were selected due to their relative percentages of certified halal meat retailers, with Illinois, Michigan, and Wisconsin having roughly 86%, 5%, and 5%, respectively, of registered *certified* halal meat stores in the Midwest. Correspondingly, three stores from Illinois,

and one each from Michigan and Wisconsin were selected to recruit consumer interviewees from. The geographic distribution of consumer interviewees is given in **Table *1***.

Table 1: Consumer sample geographic distribution

State	No. of Stores	No. of Interviewees
Illinois	3	8
Michigan	1	4
Wisconsin	1	2

At each store, customers were approached randomly and asked to participate in the study. If they agreed, they were given a card with a brief overview of the study, participation information, and were asked for their name and contact information to schedule an interview at a later time. Between 10 and 20 consumers were recruited from each store, and selected interviewees were chosen randomly from the list of those who provided contact information. Interviews were conducted over the phone or using Zoom within one week of initial contact and were between 15 and 25 minutes in length. Participants were compensated with a $50 gift card by mail or email for their time.

The second stage of this study involves conducting an online survey on a nationally representative sample of Muslim halal meat consumers. The online survey includes a hypothetical discrete choice experiment (DCE), Likert scale questions, questions to ascertain attitudes towards trust in food products and certifications, and individual demographic questions. We utilized Qualtrics ™ to recruit Muslim halal meat consumers for this survey.

3.2 Phase 2: Discrete Choice Experiment

In a DCE, participants select an individual alternative from a set of options by evaluating each alternative's characteristics, allowing us to assess the tradeoffs between the alternatives' attributes. Our DCE simulates consumers' halal meat shopping location choices and is designed to estimate consumers' valuation of halal meat certifications and trustworthy retailer relationships

using their willingness to travel (WTT) to a given retailer with various attributes and attribute levels as their WTP in this scenario. Consumers' WTT for two different halal meat certifications versus a trustworthy retailer relationship were estimated. Each choice task asks consumers to choose between shopping at one of two retail locations for their halal meat and poultry products based on their travel time, two halal meat and poultry certifications (store and individual product certifications), and the level of trust in their relationship with the retailer. These attributes and attribute levels are described in *Table 2.* Each choice task includes an image of a retail store with the appropriate certifications for each alternative to aid respondents in visualizing their choices.

Table 2: Choice Experiment Attributes & Levels

Attributes	**Attribute Levels**
Certification on products	Present / Absent
Certification on entire store	Present / Absent
Travel time to retailer	-25%, 0%, +25%
Relationship trust level with retailer	I have no relationship with this retailer The same level of relationship that I have with my current retailer I have my ideal or perfect relationship with this retailer

Selection of Attributes and Attribute Levels for DCE

There is a small body of literature specific to Islamic retailing and Muslim consumer behavior related to halal meat focused on European markets (Bonne & Verbeke 2007, Bonne & Verbeke 2008, Bonne et al. 2008, Verbeke et al. 2013, Meixner et al. 2018, Lever & Miele 2012, Tieman et al. 2013) and Southeast Asian markets (Ahmed 2008, Ali et al. 2017, Ashraf 2019, Ireland & Rajabzadeh 2011, Khan et al. 2019, Ruslan et al. 2018, Tieman et al. 2013). In general, these studies find that Muslim consumers place the most trust in Islamic butcher shops or similar ethnic marketplaces when it comes to avoiding fraudulent halal meat. Indeed, even outside of halal meat markets, consumers place higher trust in retailers with which they have an existing relationship (Becker et. al 2000). Further, confidence in meat purchasing locations was found to

differ with religiosity and immigrant status (Bonne & Verbeke 2007, 2008, Bonne et al. 2008, Verbeke et al. 2013). A study of religious consumers in Australia found that consumers made decisions for where and what products to buy based on word-of-mouth and community reputation (Nath et. al 2013). These documented preferences for retailers in which there is an established relationship support the necessity to include an attribute to account for a consumer's relationship with their retailer. This is not surprising in the context of halal meat and poultry products given the history of food fraud and the lack of uniform certification standards. Indeed, Muslim halal meat consumers interviewed in the qualitative portion of this project also expressed strong preferences for shopping for halal meat products at Islamic or ethnic retailers, though some indicated they would periodically patronize larger box stores where they knew prepackaged certified halal meat products were readily available.

Furthermore, there is support by Muslim consumers in both Muslim majority and non-Muslim majority countries for increased certification utilization for verification of authentic halal meat products (Khan et al. 2019, Meixner et al. 2018, Ruslan et al. 2018, Tieman et al. 2013). Results of consumer interviews also indicated US Muslim halal meat consumers' desire for reputable certifications for halal meat products. As such, it is prudent to include the presence of a single type of certification or combination of halal meat certification types as an attribute in the hypothetical DCE. This approach is in line with traditional consumer preference experiments in which different labels and certifications are assessed and will allow us to measure preferences between certification type (store versus product) and preferences for certifications in general.

Finally, travel time is important to include, as there is significant complexity and accessibility concerns in relation to halal meat purchasing decisions. Interviews with Muslim halal meat consumers uncovered a wide array of travel times to their preferred halal meat retailer. For

some consumers who lived near a halal meat store, their one-way travel time was half an hour or less. However, some consumers will travel a total of 3-6 hours one-way, and some even reported taking bi-annual or quarterly trips across the country to purchase the products they demand from retailers they trusted. With this potential extreme variation in travel time in the sample, utilizing fixed time increments as attribute levels may be problematic and may not truly capture the impact of travel time variation across the target population. As such, we use percentage changes relative to the individual's status quo, which will allow for more tailored attribute levels. To ensure that the relatively small changes between time levels for consumers who live very close to their preferred halal meat retailer are not trivialized in the model, we also ask participants if they took halal meat accessibility into account when choosing their place of residence.

Consumer Heterogeneity Considerations

We employ a segment-specific choice design utilizing a *library of designs* containing *reference alternatives* with a *pivot* (Choice Metrics 2018) as described in Bliemer & Rose (2014). Considering survey participants' reference alternatives (also known as reference values) is important for improved accuracy in estimation of preferences and tradeoffs across attributes in DCEs (Tonsor 2018, Caputo et. al 2020) and is especially important for this study given the heterogeneity of US Muslims' shopping experiences and individual degrees of religiosity. Furthermore, this method allows for comparison to individuals' status-quo experiences with the benefit of incorporating heterogeneity of consumers' shopping situations using a single DCE, rather than multiple or repeated experiments. Additionally, this approach mimics reality in that consumers will choose between their current store and a hypothetical alternative store. Using segment-specific designs reduces hypothetical bias in choice experiments by creating choice tasks

tailored around real experiences of agents instead of using a fixed design across the entire population (Hensher 2010, Hultkrantz & Savsin 2018, Chiu & Guevara 2019).

In a *pivot design*, attribute levels are absolutely or relatively pivoted around reference attribute levels for each individual agent (Rose et al. 2008). A pivot design is a fixed matrix $\boldsymbol{X}$ consisting of the pivot levels. In our design, we use relative pivot levels for the attribute "travel time," which allows the attribute levels to automatically scale for each individual to make the choice more realistic for short or long trips. The other attributes in the design do not pivot; instead, differences in their baseline levels are accounted for using the library of designs.

A *library of designs* allows additional segment-specificity with individually generated designs based on the reference store. To do this, we generate different designs $X^{(s)}$ for specific population segments s, $s = 1, \ldots, S$ and have each design available in a "library" within the survey instrument. In our retail store choice experiment, we create $S = 4$ different designs based on four combinations of certification labels (no certification present, certification on store but not product, certification on product but not store, and certification on both store and product). In each of these designs, store location A in each choice task is modeled off each individual consumers' current retailer of choice, otherwise known as their reference alternative, while store location B is a hypothetical alternative. For example, for an individual whose reference alternative store has no certifications, we would look up and use the design with characteristic 'no store certification' and 'no product certification' from the library. The library of designs is necessary so that the survey taker does not see two identical stores. This would occur when the time pivot value is 0%, the level of trust is the same as the consumer's current retailer, and the certification attribute levels are the same as their current store. Thus, we use constrained designs to exclude the possibility that an

individual chooses between two identical alternatives (e.g., the reference alternative A is the same as the hypothetical alternative B in a given choice task).

Segment-specific design methods can be applied with any experimental design strategy – efficient, orthogonal, or random (Bliemer & Rose 2014). Further, this approach is advantageous, as all experimental designs can be generated and checked in advance. The data generated from a library of designs is analyzed in the same manner as analyzing a single design with blocks of choice tasks – that is, pooling the data – as the same attributes and attribute levels are used in each design and we sample from the same population of consumers. An example of this approach using a library of designs that included 315 separate designs in one survey is reported in Batley et al. (2019).

Discrete Choice Experiment Design

The DCE choice tasks were generated in NGene using a D-efficient Bayesian design. Each design has two alternatives – the consumer's reference alternative store A and a hypothetical store B. There are four retailer attributes: 1) the presence of a certification for halal meat products, 2) the presence of a halal meat certification for the retail store, 3) travel time to retailer, and 4) the nature of an established trustworthy relationship between the consumer and the retailer. The travel time attribute will pivot from the reference alternative by predetermined percentages. We additionally include an interaction between the two certifications in the design. The structure of the utility function used in the design is:

$$U(store_i) = \vartheta \times CERTSTORE_i + \varpi \times CERTPROD_i + \varphi \times RELATIONSHIP_i + \tau \times TRAVEL_i + \phi \times CERTSTORE_i \times CERTPROD_i$$

Equation 1

where if i = 1, the attribute levels are set to the individual's reference alternative store A, and if i = 2, attribute levels vary for the presented hypothetical store B. The attribute levels for the store

and product certifications are "absent" and "present" (Table 2). An individual's self-reported travel time will be scaled by the appropriate percentage and the pivot will be implemented using piped text in the survey instrument. The attribute level definitions for an individual's relationship trust level with their retailer given in the instructions for the DCE presented to participants are in **Error! Reference source not found.**. A numerical value of the current relationship for each individual will be calculated using their answers to TrustID[2] scale questions, while the "no relationship" and "perfect or ideal relationship" attribute levels will be valued at the minimum and maximum TrustID scale values, respectively.

Table 3: Relationship Trust Level Attribute Level Descriptions

I have no relationship with this retailer	You have never purchased from this store before and do not know anything about their trustworthiness, friendliness, reliability, or transparency
The same level of relationship that I have with my current retailer	This is the current relationship you have with your retailer in terms of trust, reliability, friendliness, and transparency
I have my ideal or perfect relationship with this retailer	This is the most trustworthy, friendly, reliable, and transparent retailer you can imagine purchasing halal meat and poultry products from

Given that there are two alternatives in each DCE design, a full factorial design would have $(2*2*3*3)^2 = 1296$ choice tasks per design. Restricting alternative A to be the reference alternative and rejecting an identical hypothetical alternative B for each of the four designs in the library gives 35 possible choice tasks per design (140 across all four designs). Subsequently, we reduced this number to 18 choice tasks split between two blocks for each of the four designs. That is, there are eight total blocks in the DCE, corresponding to four pairs of blocks. Choice tasks are randomized within blocks to mitigate choice fatigue impacting the quality of responses. Restricting alternative

[2] The TrustID scale is a verified index used in marketing to evaluate, rank, and develop a composite score of the key components – reliability, humanity, transparency, and capability - of consumers' trust in brands or retailers (Deloitte Development 2022).

A to the reference alternative and rejecting an identical alternative B also removes the ability to have perfect attribute level balance across choice tasks and therefore orthogonality. However, we can manually impose attribute level balance for the pivoted attribute (travel time), and NGene then selects the most balanced design possible with the remaining dummy-coded attributes to optimize D-efficiency. The NGene syntax and design properties for each of the four designs in the library, the instructions participants will see prior to the choice experiment, and an example a choice task for the "no certifications" design are given in the Appendix.

Generating Priors & Finalizing Discrete Choice Experiment Design

We finalized the D-efficient Bayesian design of the DCE in three steps. First, the four designs in the library were generated assuming small positive priors for store certification, product certification, and relationship with retailer. A small negative prior was used for travel time, and a prior of zero was assumed for the interaction between the two types of certification, as we were unsure of the effect the presence of both a store and product certification will have on a consumer's choice. These designs were tested with a small number (~10% of anticipated final sample size) of consumers to generate new priors. These pre-test consumers were recruited via online Muslim halal consumer forums. The priors generated from the pre-test will be used to update the DCE design for increase efficiency. Lastly, this new DCE design will be used in the final survey that will be distributed nationwide via Qualtrics.

Theoretical Framework: Random Utility Theory

In accordance with the central idea of random utility theory (RUT), we assume U.S. Muslim halal meat consumers maximize their expected utility subject to the choices they are presented with. In this experiment, consumers are presented with two alternatives: their individual-specific reference alternative halal meat retailer and a hypothetical halal meat retailer. This method

is based on Lancastrian consumer theory (Lancaster 1966) and further defined by McFadden (1974). Lancaster proposed that a good itself does not give utility to the consumer, but that a good possesses characteristics, and these characteristics give utility. Furthermore, the utility that an individual receives from a given product (in this case, retail store) can be expressed as the sum of the utility of each of the store's attributes. The utility function can include both tangible and intangible (commonly referred to as credence attributes) characteristics of goods in the consumer demand equation. This is critical, as halal is a credence attribute that cannot be verified by the consumer when purchasing or consuming the product. Further, as researchers do not have complete information on consumers, their utility is defined as a random variable (Manski 1977). Altogether, the utility (U_{it}) obtained by selecting store *i* from a finite set of stores contained in choice set *C* in situation *t* is characterized by Equation 2:

$$U_{it} = V_{it} + \varepsilon_{it}$$

Equation 2

where V_{it} is the deterministic portion of utility dependent on the store's attributes and ε_{it} is the idiosyncratic portion of utility which is independently and identically distributed Type I extreme value over all stores (alternatives). Under the assumption that the deterministic portion utility, V_{it}, is linear in parameters, the general model of utility can be represented as:

$$\mathrm{U_{jt}} = \beta' \mathrm{X_{jt}} + \varepsilon_{\mathrm{jt}}$$

Equation 3

where $\mathrm{X_{jt}}$ is a vector of attributes in store j, β is a vector of parameters associated with these attributes, and $\varepsilon_{\mathrm{jt}}$ is the unobserved error term, which is assumed to be independent of β and X. As economic agents maximize their expected utility, a consumer will choose store *i* over store *j* if the utility of selecting *i* is greater than selecting *j* ($U_{it} > U_{jt} \; \forall \; i \neq j$).

Choice Models: Multinomial Logit

The data is analyzed using multinomial logit (MNL), mixed logit (MXL) and latent class models (LCM). For a multinomial-logit specification, the probability that a given consumer chooses store *i* among *C* alternatives is given by:

$$P(i\,|X,\beta) = \frac{e^{\mu x_i \beta}}{\sum_{j=1}^{C} e^{\mu x_j \beta}}$$

Equation 4

where *X* and β are defined as in Equation 3 and μ is the unidentified scale factor that is typically set equal to one. To account for possible unobserved heterogeneity in the coefficients, we assume that the coefficients are independently and normally distributed, and that their joint distribution is $f(\beta|\Theta)$ with support β, where Θ is a set of parameters that characterize the distribution of these preferences.

However, multinomial logistic models assume that consumers have homogeneous preferences, which is unlikely to be true. Thus, a multinomial logistic model will provide poor estimates and it is instead useful to use a more general models that allow for heterogeneity in preferences, such as the MXL and LCM.

Choice Models: Mixed Logit

Mixed logit models – also known as random parameter logits (RPLs) – are a way to account for consumer preference heterogeneity and allow us to directly estimate this heterogeneity across attributes. Each of the respondents saw nine choice tasks, resulting in a "panel" of responses from each individual. We assume that unobserved preferences vary across respondents, but not within each respondent's set of choice tasks. Thus, we define a mixed-logit choice model where the probability that a given consumer chooses store *i* in choice scenario *t* is:

$$C(i_t|X,\Theta) = \int_{\beta} \prod_{t} P(i_t|X,\beta) f(\beta|\Theta) d\beta$$

Equation 5

where β is a vector of random parameters which has its own mean and variance, representing individual preferences. $C(i_t|X,\Theta)$ averages the product of the multinomial logit probabilities across all possible values of β (Masiero & Rose 2013). The choice-probability integral in Equation 5 does not have a closed-form solution, so the parameters will be estimated using simulated maximum likelihood estimation (MLE) methods. In this model, we will use ~500-1000 Halton draws to simulate the likelihood function.

Choice Models: Latent Class

Alternatively, we can assume that heterogeneity in preferences can occur discretely for different groups of individuals. Using a latent class approach with *S* latent classes, we sort individuals into classes where individuals within a given class have homogeneous preferences, but preferences vary across classes (Boxall and Adamowicz 2002). In a latent class logit model, $f(\beta|\Theta)$ is discrete, taking S distinct values (Train 2003). The probability that individual *n* selects store *i* in a given choice situation *t* unconditional on the class is represented by:

$$P_{nit}(i\,|X,\beta) = \sum_{s=1}^{S} \frac{e^{\mu\beta_s' x_{nit}}}{\sum_{j=1}^{C} e^{\mu\beta_s' x_{njt}}} R_{ns}$$

Equation 6

where β_s is the parameter vector for class S and R_{ns} is the probability that consumer *n* falls into latent class S. R_{ns} is modeled as follows:

$$R_{ns} = \frac{e^{\theta_s' z_n}}{\sum_r e^{\theta_r' z_n}}$$

Equation 7

where θ_S is the vector of parameters for consumers in class S and z_n is the set of observable characteristics that determine class membership (Ouma et al. 2007).

Asymmetric Utility Specification

Asymmetric discrete choice models are advantageous, as they let us model the discrepancies between willingness to pay (WTP) and willingness to accept (WTA) in reference

dependent experiments. Reference dependent models are unique in that they allow us to capture loss aversion, a behavioral phenomenon that influences how individuals make choices. According to Kahneman and Tversky (1979), individuals are loss averse if they place stronger weight on losses rather than gains when making choices. It follows that loss aversion is present if the absolute value of the coefficient associated with losses is larger than the absolute value of the coefficient associated with gains.

We express the observed portion of the utility function (V_{nit}) with reference dependence using two asymmetric specification methods detailed in Masiero & Rose (2013) and adapted to this choice context in ***Error! Reference source not found.*** and *Equation 9*. In both equations, the subscript *rn* denotes the attribute level for reference store A and the subscript *it* denotes the attribute level for hypothetical store B. The model in **Error! Reference source not found.** is the typical structure of asymmetric utility seen in the literature (e.g., Hess et al., 2008; Masiero and Hensher, 2010, Tonsor 2018), defined according to positive and negative deviations from the reference alternative values where the stated choice experiment includes the reference alternative in the choice set:

$$\begin{cases} V_{nit} = ASC_i + \beta_{n1}(s_{it} - s_{rn}) \times I_{s_{rn}<s_{it}} + \beta_{n2}(s_{it} - s_{rn}) \times I_{s_{rn}>s_{it}} + \\ \beta_{n3}(p_{it} - p_{rn}) \times I_{p_{it}<p_{rn}} + \beta_{n4}(p_{it} - p_{rn}) \times I_{p_{it}>p_{rn}} + \beta_{n5}(r_{it} - r_{rn}) \times I_{r_{it}<r_{rn}} + \\ \beta_{n6}(r_{it} - r_{rn}) \times I_{r_{it}>r_{rn}} + \beta_{n7}(d_{it} - d_{rn}) \times I_{d_{it}<d_{rn}} + \beta_{n8}(d_{it} - d_{rn}) \times I_{d_{it}>d_{rn}} \\ V_{nref} = 0 \end{cases}$$

Equation 8

Specifically, s_{rn} and s_{it} are the store certification levels, p_{rn} and p_{it} are the product certification levels, r_{rn} and r_{it} are attribute levels of the consumer's relationship with the retailer, and d_{rn} and d_{it} are the attribute levels for travel time to the retail store. Furthermore, $I_{s_{it}<s_{rn}}$, $I_{p_{it}<p_{rn}}$, $I_{r_{it}<r_{rn}}$, and $I_{d_{it}<d_{rn}}$ are indicator functions equaling one if the reference attribute level is lower or "worse"

than the hypothetical attribute level and zero otherwise. $I_{s_{it}>s_{rn}}$, $I_{p_{it}>p_{rn}}$, $I_{r_{it}>r_{rn}}$, and $I_{d_{it}>d_{rn}}$ are indicator functions equaling one if the reference value is higher or "better" than the hypothetical attribute level and zero otherwise. The β_{nk} on the (differenced) explanatory variables are the corresponding coefficients.

Equation 9 is the model for an experiment that includes the reference alternative in the choice set where the asymmetric specification with the reference alternative values is not normalized to zero, and gains and losses expressed in absolute values (Rose and Masiero 2010). In this specification, we define the model to utilize absolute values and then calculate the differences from the reference point in terms of marginal utilities.

$$\begin{cases} V_{nit} = \beta_{n1}(s_{it} - s_{rn}) \times A_{s_{rn}<s_{it}} + \beta_{n2}(s_{it} - s_{rn}) \times A_{s_{rn}>s_{it}} + \beta_{n3}(p_{it} - p_{rn}) \times A_{p_{it}<p_{rn}} \\ \quad +\beta_{n4}(p_{it} - p_{rn}) \times A_{p_{it}>p_{rn}} + \beta_{n5}(r_{it} - r_{rn}) \times A_{r_{it}<r_{rn}} + \beta_{n6}(r_{it} - r_{rn}) \times A_{r_{it}>r_{rn}} \\ \quad +\beta_{n7}(d_{it} - d_{rn}) \times A_{d_{it}<d_{rn}} + \beta_{n8}(d_{it} - d_{rn}) \times A_{d_{it}>d_{rn}} \\ V_{nref} = \beta_{n9} \times s_{rn} + \beta_{n10} \times p_{rn} + \beta_{n11} \times r_{rn} + \beta_{n12} \times d_{rn} \end{cases}$$

Equation 9

Here, $A_{s_{it}<s_{rn}}$, $A_{p_{it}<p_{rn}}$, $A_{r_{it}<r_{rn}}$, and $A_{d_{it}<d_{rn}}$ are indicator functions equaling the hypothetical attribute level if it is less or "worse" than the reference alternative attribute level and zero otherwise. $A_{s_{it}>s_{rn}}$, $A_{p_{it}>p_{rn}}$, $A_{r_{it}>r_{rn}}$, and $A_{d_{it}>d_{rn}}$ are indicator functions equaling the hypothetical attribute level if it is higher or "better" than the reference attribute level and zero otherwise.

Both models will serve to describe the data, though we anticipate that the model in **Error! Reference source not found.** will provide better fit due to the nature of the choice tasks, as we do not express all the attribute levels in the hypothetical alternative in terms of absolute deviations from the reference alternative. The models defined in **Error! Reference source not found.** and *Equation* 9 will be estimated in NLOGIT 6 and results compared. Additional details for developing the asymmetric models in **Error! Reference source not found.** and *Equation* 9 and empirical

examples in transportation contexts are given in Hess (2008), Hess et al. (2008), Masiero & Rose (2013), and Masiero & Henseher (2010).

Estimation of Random Parameters

As is common in the literature (Masiero & Rose 2013), the coefficients β_{nk} are assumed to be distributed normal such that:

$$\beta_{nk} = \beta_k + \eta_{nk}$$

Equation 10

where $\eta_{nk}$is a random disturbance from a normal distribution to capture preference heterogeneity across individuals. The utility parameters are estimated by maximizing the following simulated maximum log likelihood function where *t* = 1, …, T represents the number of choice tasks in the "panel" presented to each individual and m = 1, …, M is the number of draws used to identify each parameter:

$$LL = \sum_n ln \frac{1}{M} \sum_m \prod_t \frac{e^{(\alpha_i + \sum_k \beta_{nk}^m x_{ntik})}}{e^{(\alpha_j + \sum_k \beta_{nk}^m x_{ntjk})}}$$

Equation 11

Deriving Willingness to Pay and Willingness to Accept:

We can use the coefficients from *Equation 8* and *Equation 9* to derive WTP and WTA estimates (Masiero & Rose 2013). When the indicator functions represent a "gain" or "better off" scenario, WTP is estimated as:

$$WTP_k = \frac{\beta_{nk}}{\beta_{n7}}$$

Equation 12

where and β_{n7} is the parameter associated with the cost of losses. When the indicator functions represent a "loss" or a "worse off" scenario, WTA is estimated as:

$$WTA_k = \frac{\beta_{nk}}{\beta_{n8}}$$

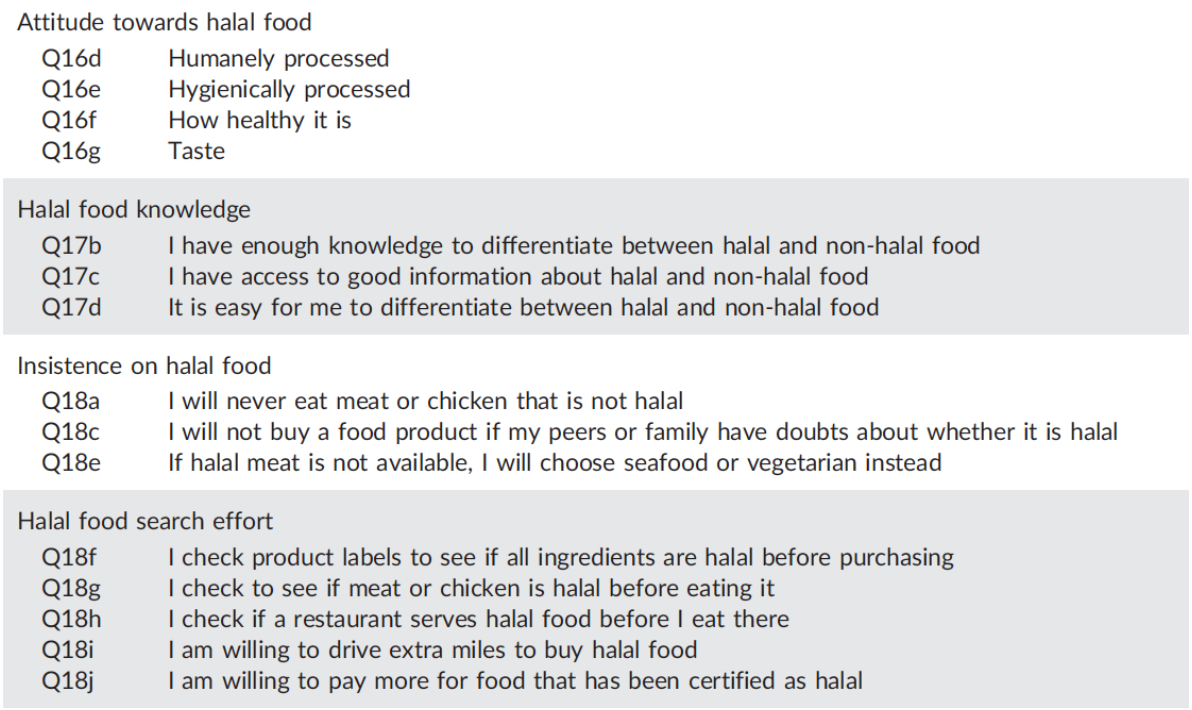
Equation 13

where β_{n8} is the parameter associated with the cost of gains.

3.3 Phase 2: Likert Scale Questions

In addition to the hypothetical CE, the online survey included a series of Likert-type scale questions to account for additional factors that may influence a consumer's preferences for halal meat products, retailers, and certifications. These include measurements of consumers' halal meat search effort, insistence on halal meat products, knowledge of halal meat production methods, and attitude towards halal meat. These scales were utilized in Mumuni et al. (2018) and constructed from Cleveland and Chang (2009), Salehudin (2010), and Ambali, Ahmad, and Bakar (2014) using acceptable measurement development procedures from Churchill (1979). The relevant scale questions are illustrated in **Figure *1***. This approach to measuring consumers' attitudes towards halal meat is inspired by studies suggesting that halal food not only has religious associations, but is often perceived to be healthier, tastier, and more hygienic by Muslims and non-Muslims alike (Ayyub, 2015; Regenstein et al., 2003).

Figure 1: Likert-type scale questions for evaluating additional factors that may influence consumers' preferences for halal meat shopping attributes (Mimuni et al. 2018)



Attitude towards halal food	
Q16d	Humanely processed
Q16e	Hygienically processed
Q16f	How healthy it is
Q16g	Taste
Halal food knowledge	
Q17b	I have enough knowledge to differentiate between halal and non-halal food
Q17c	I have access to good information about halal and non-halal food
Q17d	It is easy for me to differentiate between halal and non-halal food
Insistence on halal food	
Q18a	I will never eat meat or chicken that is not halal
Q18c	I will not buy a food product if my peers or family have doubts about whether it is halal
Q18e	If halal meat is not available, I will choose seafood or vegetarian instead
Halal food search effort	
Q18f	I check product labels to see if all ingredients are halal before purchasing
Q18g	I check to see if meat or chicken is halal before eating it
Q18h	I check if a restaurant serves halal food before I eat there
Q18i	I am willing to drive extra miles to buy halal food
Q18j	I am willing to pay more for food that has been certified as halal

For the Likert-type scale questions, we apply factor analysis methods in Stata (Stata 2013), as well as an ordinal logistic regression to model summative scale values as a function of individual and religious demographics (Winship & Mare 1984). Finally, data analysis includes reports of summary statistics to describe current Muslim halal meat consumers.

Demographics Questions

The individual demographics questions included in the survey consist of the standard socioeconomic questions typically seen in survey data collection, as well as questions about their ethnic and cultural background, immigration status or generation of citizenship, religious history (i.e., born and raised Muslim versus converting to the faith), subsect of Islam that they practice, and other cultural or religious characteristics that could influence perceptions and preferences related to the US domestic halal meat market. Additionally, members of the Islamic community

were asked to look over the survey for clarity and to ensure there were no misrepresentations prior to distribution.

4. Results and Discussion

Results available upon request to the authors.

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