Accounting For Heterogeneity In Behavioral Responses To Health-Risk Information Treatments

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Abstract

Traditional revealed and stated preference models consider a typical individual's behavioural responses to various policy-based information treatments. For some cost–benefit applications in which resource managers are concerned with responses from a representative individual, this is sufficient. However, as behavioural responses to information treatments can vary across respondents, we develop a latent class analysis with covariates to examine unobserved heterogeneity responses to health-risk information treatments. Results from a probabilistic model indicate that classes of consumers respond differently to the health-risk information treatments. Principally, we find that the media form of the information treatment is important, with raw consumer groups typically more responsive to a brochure information treatment, while cooked oyster consumers are more responsive to the same information in a video format. We also find that a proposed US Food and Drug Administration policy on processing all raw oysters before market has a greater effect on reducing demand for consumers of cooked oysters. However, with an associated price premium, all consumer classes reduce demand. Overall, the results suggest that future policy-based research could benefit from examining potential heterogeneity in individuals' responses to risk information treatments in order to fully understand the efficacy of treatments on behaviour.

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Abstract Traditional revealed and stated preference (RP/SP) models consider a typical individual's behavioral responses to various policy-based information treatments. For some cost-benefit applications in which resource managers are concerned with responses from a representative individual, this is sufficient. However, as behavioral responses to information treatments can vary across respondents, we develop a latent class analysis to examine unobserved homogenous subgroup responses to health-risk information treatments. Results from a probabilistic model indicate that homogenous classes of consumers respond differently to the health-risk information treatments. This suggests that future policy-based research could benefit from examining potential heterogeneity in individuals' responses to risk information treatments in order to fully understand the efficacy of treatments on behavior.

JEL Q18, Q22, Q51

Introduction

In the non-market valuation literature, the merging of revealed and stated preference data (RP/SP) has been used in multiple policy-oriented analyses.[1] Typically, these RP/SP studies examine individuals' preferences across a sample population such that individuals' behavioral changes to SP treatments are gauged by the average person in the sample. While this may be sufficient in some cost-benefit applications in which resource managers are concerned with responses from a representative individual, in other cases, SP scenarios may affect individuals' preferences in different ways. If individuals' behavioral responses to different SP treatments vary across the population, then interpretation of average responses in a traditional framework may be tenuous.

One potential method of modeling heterogeneity of preferences across individuals in a RP/SP framework is to estimate split-sample models that vary based on researcher-determined characteristics. For example, Haab et al. (2010) consider four different gender and race categories to examine the effects of negative and positive risk information on perceived seafood risks from a series of fish kills and seafood consumption. They find that the demographic groups respond to the positive and negative risk information in different ways. As the information treatments only altered risk perceptions in the intended direction for one group, they discuss that risk communication strategies continue to be a challenge and future research should consider the role of demographics and class on the effectiveness of risk communication instruments. In a similar vein, Morgan et al. (2012) develop four split-sample models to examine oyster consumers' responses to health-risk information. The models are split dependent on consumers'

[1] For example, Earnhart (2001) examines the benefits to homeowners from environmental amenities and coastal restoration; Whitehead, Haab, and Huang (2000) estimate the recreation benefits of environmental quality improvements; Morgan, Massey, and Huth (2009) consider the welfare effects of creating an artificial reef diving site in the Gulf of Mexico; and Huang et al. (2011) consider the impact of erosion and erosion control programs on beach recreation.

health and behavioral characteristics that were gathered as part of the survey process. They also find that individuals' responses vary by subgroups, with certain subgroup responses contrary to researcher expectations. This method has direct merit in examining heterogeneity in responses to SP treatments if responses from specific subgroups of the population are of interest to the researcher and the applicable individual-variant characteristics are known. If not, a latent class analysis (LCA) is another approach that can be used to examine responses from different classes of consumer. LCA estimates separate parameter estimates for survey respondents who possess similar, but unobserved, preferences (McLachlan and Peel 2000). Again from a policy-based perspective, LCA can provide an extra layer of insight into the impact of different SP scenarios on individual behavior.

For a LCA, two methods exist. The first is a continuous mixture approach that models heterogeneity in the form of continuous distributions. There are two RP/SP papers that adopt this method. Egan and Herriges (2006) use RP/SP panel data from an on-site sample to examine recreator behavior at Clear Lake, Iowa. Von Haefen and Phaneuf (2008) account for preference and attribute heterogeneity in a RP/SP environmental application to identify discrete choice demand parameters for moose hunters in Canada. The second possible method is a finite mixture (or LCA) approach. In this method, heterogeneity across individuals is modeled with a set of classes, characterizing classes from observed measures and allowing individual preferences and characteristics to simultaneously explain behavior. Hynes and Greene (2013) estimate the first LCA model for RP/SP data in a recreation demand context. In considering the two approaches, for policy-based analyses, Swait (1994) argues that a LCA, or finite mixture approach, is preferred as the classes are behavior-based and so, are more relevant to management and decision making.

We develop a policy-based LCA approach to model potential unobserved heterogeneity of oyster consumers' responses to actual and proposed foodborne health-risk information and processing technology treatments. The treatments are based on actual and proposed policies by the U.S. Food and Drug Administration (FDA) and Interstate Shellfish and Sanitation Conference (ISSC), designed to reduce the annual number of illnesses and deaths associated with consuming raw, Gulf of Mexico oysters. A traditional RP/SP approach would not capture preference heterogeneity. For example, Parsons et al. (2006) examine health-risk information brochures on consumer behavior following large scale fish kills along the mid-Atlantic coast. Results indicate that the brochure treatments do not influence behavior of the typical consumer in the sample – a result that supports findings from other studies (see Brown and Schrader 1990; Smith, van Ravenswaay, and Thompson 1988; Wessells and Anderson 1995). However, this result does not inform as to whether behavior of any subgroups of the sample population would differ from the average response to the treatment. The benefit of the LCA approach is that behavior of subgroups can be analyzed. From a policy perspective, if behavior varies across homogenous subgroups, policymakers may want to invest additional effort into examining how different population subgroups respond to policy treatments in order to understand the efficacy of treatments in altering behavior.

In the analysis, we develop both a standard pooled RP/SP model and two LCA models to analyze individuals' responses to different information treatments that vary by both media form and source using the data from Morgan et al. (2012). We find that health-risk information consistently influences behavioral responses from some subgroups, or classes of the population, yet responses from other subgroups vary dependent on both media and source effects. From a policy perspective, the findings highlight why an existing risk information strategy has had a negligible effect on behavior, and why a new proposed policy will be detrimental to the industry as a whole.

Background and Survey Design

A full discussion of the potential health risks to oyster eaters and the *Vibrio vulnificus* (*V. vulnificus*) bacteria, the current regulatory stance of the FDA, and a full description of the survey design developed for this research can be found in Morgan (2012). The following provides a brief synopsis of these components. *V. vulnificus* is a bacterium found predominantly in the same coastal waters in which Gulf of Mexico oysters feed, so the bacteria can concentrate in the oyster tissue. When consumers with immune-compromised health conditions (such as liver disease or diabetes) eat these oysters raw, there is a risk of ingesting the bacteria and becoming seriously ill or dying. Approximately 36 consumers die each year in the U.S. from consuming raw oysters infected by *V. vulnificus* (Scallan et al. 2011). Efforts by the FDA and ISSC under the National Shellfish Sanitation Program (NSSP) to reduce annual illness and death rates include informational brochures that detail the risks of consuming raw Gulf of Mexico oysters, and a new proposal to require post-harvest processing of all raw oysters to reduce bacteria levels in oysters.

In a RP/SP framework, we investigate oyster consumers' responses to the current and proposed health-risk information treatments regarding *V. vulnificus*. In an online survey of internet-based oyster consumers (aged 18 and over), respondents from the U.S. Center for Disease Control-designated "case states" are asked one revealed preference and seven stated preference questions regarding the annual number of oyster meals consumed under existing conditions and having been presented with different *V. vulnificus* health-risk information treatments.[2] Initially, respondents are asked to reveal the annual number of oyster meals that they consume, where an oyster meal consists of any meal, appetizer or main course that contains oysters, or where oysters are an important ingredient in the dish (revealed preference). The first three stated preference questions then ask respondents for their expected annual oyster meals consumed under existing conditions, and under a price increase and price decrease scenario.[3] The exact script for the seven SP questions is detailed in Table 1. The remaining four SP scenarios elicit expected annual oyster meal counts under different health-risk information treatments.

For the fourth SP scenario, respondents are randomly assigned one of three potential health-risk information treatments. The first is the existing ISSC brochure that details the facts associated with *V. vulnificus*; the necessary health conditions required to be considered at-risk; potential illnesses; diagnosis and treatment; and risk prevention recommendations. The second possible treatment is a streamed health-risk video, created by the research team that disseminates exactly the same information as the brochure but via a different media form.[4] For both treatments, the source of the information is varied by: (1) no source (the control group); (2) the FDA; (3) the ISSC; and (4) a researcher-created fictitious not-for-profit group called the American Shellfish Foundation (ASF). Combined, this enables an examination of behavioral responses to different media and source forms of the information. Finally, the third potential treatment is an alternative video that has the same content as the standard video with the exception that it only mentions morbidity risk from consuming raw oysters, not mortality risk. The source of the alternative video is also varied across respondents.

[2] A "case state" refers to a state in which an individual has died from consuming a raw, Gulf of Mexico oyster. These are Florida, Alabama, Mississippi, Louisiana, Texas, and California,

[3] Each respondent receives a price increase of $1, $3, $5, or $7, or a price decrease of either $1, $2, $3, $4, while being informed that the price of all other food products remains the same

[4] The full video is available for viewing at http://vimeo.com/7035554

The fifth SP scenario presents respondents with a hypothetical news article reporting a recent consumer illness and death from eating raw Gulf of Mexico oysters. While the article is hypothetical, it is based on actual events, describing a middle-aged man that fell ill from consuming raw oysters, spent a week in hospital but then died from his sickness. In this scenario, the place of residence for the deceased consumer is described as either local or non-local, with respect to the respondents' state of residence.

In the sixth SP scenario, respondents are provided with textual material on PHP treated oysters informing them that there are currently four FDA-approved PHP methods, all of which reduce *V. vulnificus* to non-detectable levels. The follow-up SP question elicits respondents' annual oyster meal count after reading about PHP and assuming that the only oysters available are those that have been Post-Harvest Processed. Finally, as Muth et al. (2011) indicate that the PHP process will likely increase the price of a dozen raw half-shell oysters by between $0.48 to $0.84 to the consumer, we ask a seventh SP question regarding expected annual oyster meals consumed with an associated price premium.[5]

The sample was drawn from a panel of online respondents maintained through Online Survey Solutions, Inc. (OSS) and the survey was administered between March and April, 2010.[6] In total, there were 1,849 completed responses from oyster consumers across the seven states. Table 2 provides sample definitions and descriptive statistics for variables used in the analysis. The average respondent in the sample is 44 years of age, Caucasian, and earning a household income of $69,000. Just over half of the sample is female consuming an average of 16 oyster meals per year. Approximately 62 percent of the sampled consumers eat raw Gulf of Mexico oysters while 18 percent of the sample is "at risk" from consuming raw Gulf of Mexico oysters

[5] Price premiums are varied randomly across respondents as $1, $3, $5, or $7.

[6] All observations were collected before the BP *Deepwater Horizon* Gulf oil spill.

as they revealed that they have one of the necessary health conditions to be classified in this group. The response rate was 53percent.

The Conceptual Framework

The online survey instrument collects RP and SP data for analysis in a basic oyster demand model of the average consumer in the sample. The RP data is based on actual annual number of oyster meals consumed and the SP data refers to expected meals resulting from price changes and the provision of different information treatments. SP meal questions are asked about future meals consumed: (1) under status quo conditions, (2) with a price increase and decrease scenario, (3) with the provision of a brochure or video, (4) with news of a *V. vulnificus*-related death, (5) with a mandatory PHP policy, and (6) with a mandatory PHP policy and associated price premium.

As the dependent variable is a nonnegative integer with a high frequency of low meals consumed, a linear count panel data specification is estimated. A basic count model is assumed and is written as:

$$\Pr(x_{it}) = \frac{e^{-\lambda_{it}}\lambda_{it}^{x_{it}}}{x_{it}!}, x_{it} = 0,1,2,\ldots \qquad (1)$$

The natural log of the mean number of meals is assumed to be a linear function of prices, the perceived chance of becoming ill from consuming oysters, income, and scenario dummy variables. To allow for variation across oyster consumers that cannot be explained by the independent variables, we assume that the mean number of meals also depends on a random error, u_i. The random effects Poisson model imposes positive correlation across the t scenarios (Landry and Liu, 2011). The pooled RP/SP Poisson demand model is:

$$ln\lambda_{it} = \beta_0 + \beta_1 P_i + \beta_2 c_i + \beta_3 y_i + \beta_4 \boldsymbol{s}_i + \beta_5 I + \beta_6 N + \beta_7 PHP + \beta_8 PHP_{prem} + \beta_9 SP + \mu_i \quad (2)$$

where P is the price of an oyster meal; y is income; c is a scaled dummy reflecting an individual's perceived chance of becoming sick from oyster meals; $\boldsymbol{s}$ is a vector of socio demographic variables; individuals are indexed i = 1, …, 1,849; and t = 1, …,8 denotes annual oyster meal demand under RP status quo, SP status quo, SP price increase, SP price decrease, SP information treatment, SP news treatment, SP PHP treatment, and SP PHP treatment with price premium, respectively, in the pseudo-panel data. Dummy variables I (I = 1 when t = 5), N (N = 1 when t = 6), PHP (PHP = 1 when t = 7), and PHP_{prem} (PHP_{prem} = 1 when t = 8) are demand shift variables for the information, news, and PHP treatment scenarios. The SP dummy variable is included to test for hypothetical bias. SP = 1 for hypothetical meal data (t = 2, …, 8) and 0 for revealed meal data (t = 1). $\beta_0 - \beta_9$ are coefficients to be estimated in the model. Pooling the data suggests that panel data methods be used to account for differences in variance across sample individuals, i, and scenarios, t. The distribution of meals conditioned on u_i is Poisson with conditional mean and variance, λ_{it}. If exp(λ_{it}) is assumed to follow a gamma distribution, then the unconditional meals, x_{it}, follow a negative binomial distribution (Hausman, Hall, and Griliches 1984).

Using the coefficients from the semi-log model, to illustrate individual welfare measures for consumers, average annual per-person consumer surplus (CS) estimates are calculated as:

$$CS_{SP=0} = \frac{\hat{x}}{-\beta_1} \quad (3)$$

where $\hat{x}_{SP=0}$ is the annual number of predicted meals for the representative oyster consumer when controlling for potential hypothetical bias (corrected model) and all independent variables are set at sample means (Bockstael and Strand 1987).

We compare results from the standard pooled RP/SP model to a latent class model allowing behavioral responses to the health-risk information treatments to be examined across classes of consumer. Formally, the latent class model is described by an individual consumer that resides in a latent class, *c*. The individual class membership (denoted by C_i^*= 1,…,*n*) is unknown (latent) to the researcher. The underlying utility of individual *i's* consumption *x*, under information treatment *t*, given that the individual belongs to latent class *c*, can be expressed as:

$$U_{ixt} = \beta_c' \boldsymbol{X}_{ixt} + \varepsilon_{ixt} \quad (4)$$

where $\boldsymbol{X}_{ixt}$ is a union of all attributes that appear in all utility functions, β_c' is a class specific parameter vector, and ε_{ixt} indicates the unobserved heterogeneity for individual *i*'s consumption *x*, under information treatment *t*.

For each class, the actual number of annual meals consumed, x_i, is assumed to be drawn from a Poisson distribution. Within each class, the underlying parameters of the Poisson distribution are allowed to vary. Specifically, we assume that:

$$\Pr(y_i^* = m | C_i^* = c) = \frac{\exp(-\lambda_{ic})\lambda_{ic}^m}{m!} \; i = 1, \dots, I: c = 1, \dots, n \quad (5)$$

where $\lambda_{ic} = \exp(\boldsymbol{X}_i'\beta_c)$ represents the conditional mean number of oyster meals consumed in class *c* given characteristics $\boldsymbol{X}_i$ and the parameter vector β_c.

Estimation results

Before presenting and discussing the results from the LCA and highlighting heterogeneous consumer behavior with respect to health-risk information treatments, Table 3 presents the regression results from a random effects Poisson oyster demand model. This is a traditional pooled RP/SP model that examines the effect of different information and PHP treatments on oyster demand for the average consumer. Here, we briefly summarize the findings from the standard model, comparing the main results to other food safety demand-side studies and highlighting the contributions of the standard model to this literature.

First, the price coefficient is negative and statistically significant so respondents behave in line with economic theory. Based on an average of 16.3 oyster meals consumed each year, this represents an annual average per-person consumer surplus of $438 with a 95 percent confidence interval ranging from $427 to $449. The annual per-person consumer surplus estimate is calculated for a corrected (SP=0) version of the model together with 95% confidence intervals constructed using a bootstrapping procedure (Krinsky and Robb 1986). The procedure generates 1,000 random variables from the distribution of the estimated parameters and generates 1,000 consumer surplus estimates. The estimates are sorted in ascending order and the 95% confidence intervals are found by dropping the bottom and top 2.5% of the estimates.

Income is positive so oysters are normal goods. The negative coefficients on the *AT-RISK* and *SICK* parameters indicate that oyster consumers vulnerable to illness from *V. vulnificus* eat fewer meals than non-immune-compromised consumers, and the average consumer reduces meals consumed when the perceived risks of consumption are greater.

Results support other studies analyzing consumer responses to health scare events as news highlighting *V. vulnificus* risk significantly reduces demand (see Swartz and Strand 1981; Anderson and Anderson 1991; Ahluwalia et al. 2000; Parsons et al. 2006). We augment other approaches in this area by analyzing responses to both local and non-local health scare events. We find that news of a death to a local oyster consumer caused by a *V. vulnificus* infection (*NEWS_LOC*) causes a larger decrease in demand than for the same non-local event.

For the positive brochure treatments, results are perhaps stronger than findings from other studies (Fox, Hayes, and Shogren 2002; Parsons et al. 2006: Morgan, Martin, and Huth 2009). Typically, these studies show that consumer responses to positive risk information treatments have a negligible effect on risk perceptions and demand, and so responses to existing negative information consistently dominate. Our findings indicate that the majority of the brochure and source combination treatments cause the average consumer to actually reduce their demand for oysters. Even though the information is designed to reassure most consumers that oysters are safe to eat, while also highlighting the necessary health characteristics that may put a consumer in the at-risk category, it seems that these treatments cause individuals to act defensively and reduce their demand for oysters. This perhaps suggests that the brochure highlights the issue of *V. vulnificus* that the typical oyster consumer hadn't previously considered. Looking at results across treatments, there is partial evidence of media and source effects. In general, information presented in brochures has a greater negative effect on demand than the same information presented in a video format (media effect). In terms of source effects, information sourced to the not-for-profit entity (ASF) appears to raise risk perceptions and decrease demand, while neither treatment sourced to the government agency (FDA) significantly reduces demand, with *VIDFDA* actually increasing consumption.

Comparing consumer responses to the standard and alternative video, in line with research in the social psychology literature (Maddux and Rogers 1983; Abraham et al. 1994), it appears that fear appeal influences demand. The standard videos (that mentions mortality risk only) generally cause a decrease in demand, while the alternative video (that only discusses morbidity risk) typically has the opposing effect.

The coefficient on the *PHP* parameter provides feedback to the FDA and interested stakeholders regarding consumer acceptance of a treated oyster. The *PHP* coefficient is negative and statistically significant at the 1 percent level indicating that if only PHP oysters are available at market then this will induce a decrease in demand. Given this finding, unsurprisingly *PHP_prem* is negative and significant so demand decreases following the introduction of a PHP oyster with a price premium. As the PHP process will increase the price of raw oysters to the consumer, our results provide strong empirical evidence that restricting the sale of oysters in the summer months to only PHP oysters will have significant negative effects on the oyster industry as consumers decrease their quantity demanded for the processed product.

Now we move on to consider the results from a LCA that allows behavioral responses to the information treatments to be examined across subgroup populations. Recall, the purpose of the LCA is to demonstrate the potential to highlight heterogeneity in consumer behavioral responses to current and proposed health-risk policy directives. In this scenario, rather than analyzing the average consumer response to risk information, we are interested in examining how different classes of consumer react to the same treatments. We estimate two LCA models. First, we estimate a full model (that includes consumers of both raw and cooked oysters) with 2, 3, and 4 classes and then compare two measures of fit (Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC)). The 3-class model dominates with lower AIC and BIC measures (Table 4). The 4-class model failed to converge. Further, as to be vulnerable to a *V.*

vulnificus infection, oysters must be consumed in a raw state, we also run a separate 3-class LCA model to examine heterogeneous behavior with respect to consumers of raw oysters. [7]

Tables 5 and 6 present the results from a latent class pooled Poisson model with random effects for all oyster consumers and for raw oyster consumers only, where we focus on the same specification as the standard model.

Examining results from both models provides some interesting intuition into behavior both within and between consumer types. For all consumers, class membership probability parameters suggest that there is a 13 percent chance that a member of the sample is in Group 1, a 51 percent chance that a member of the sample is in Group 2, and a 36 percent chance of being in Group 3. As expected, the price coefficient is negative and statistically significant across all groups but based on the size of the coefficients, consumer welfare for oyster meals varies. Price coefficients suggest that per-person annual consumer surplus in the three classes are $443.3 (with a 95% confidence interval of $420.5 to $466.1), $284.1 (with a 95% confidence interval of $251.3 to $316.9), and $364.0 (with a 95% confidence interval of $339.8 to $388.3). For raw consumers, class membership probability parameters indicate a 10 percent, a 66 percent, and a 24 percent chance that a member of the sample is in Group 1, 2, and 3, respectively. Price coefficients in the raw consumers only model suggest that per-person annual consumer surplus in the three classes are $487.7 (with a 95% confidence interval of $429.3 to $546.1), $240.4 (with a 95% confidence interval of $165.8 to $315.0), and $430.1 (with a 95% confidence interval of $358.7 to $501.5).

In both models, across groups, income coefficients are positive and significant, so like the average consumer in the sample, all classes of oyster consumer treat oysters as a normal good.

[7] By survey design, after each SP scenario we ask the respondent to state how many meals consumed are raw meals so we can break out raw meals from the total number of meals consumed under each SP scenario.

However, the size of the coefficients suggests a greater variability in income effects for raw consumers, and also that raw consumers are more responsive to changes in income.

In RP/SP models, inclusion of a SP parameter can be used as a means to control for potential hypothetical bias in individual responses. LCA results show that expected behavior varies across classes. One class of consumer in each LCA model indicates that they expect to consume more meals in the future while other subgroups do not anticipate any change in consumption behavior.

For both types of consumer, the *SICK* coefficients perhaps indicate differences in terms of risk seeking/avoidance behavior across subgroups. Some classes of consumer indicate that they would increase oyster consumption when perceived risks rise. As this is particularly evident for consumers of the raw, riskier product, perhaps these classes of consumer exhibit more risk seeking behavior or a form of optimistic bias, where behavior reflects an unrealistic expectation that the individual consumer is less likely to experience a negative event than their peers. Other classes of consumer are more risk averse, so an increase in perceived risk causes a decrease in demand.

The *AT-RISK* coefficient is negative and statistically significant across all classes, so immune-compromised consumers, vulnerable to a *V. vulnificus* infection, eat fewer oyster meals than not at-risk individuals. Further, as the disparity is greater for raw oyster consumers, this finding signifies that, having controlled for risk preferences, at-risk consumers seem aware of the inherent risk of consuming oysters.

LCA results clearly indicate that responses vary across subgroups with regard to the policy-based health-risk information treatments. For the ISSC brochure that causes the average consumer in the sample to decrease oyster demand, some subgroup populations across both models are either non-responsive or increase demand following exposure to the brochure. From a policy perspective, this is potentially the most striking result. This is the actual brochure disseminated to individuals across the case states under the 2001 *Vibrio vulnificus* Risk Management Plan for Oysters. This brochure/source combination had a negligible impact on reducing consumer illnesses. Based on the standard model result, one would expect that these brochures should have had a greater impact on reducing illness and death. However, the LCA findings indicate that some consumers will continue to expose themselves to the health risks, so *V. vulnificus*-related illnesses and deaths are likely to continue.

Considering all other positive risk information treatments, in both models, one class of consumer (Class 1) is clearly more responsive to risk information. For this group, source effects are also evident as responses vary within treatments. Other classes are less responsive, in general. In terms of media effects, some subgroups are more responsive to brochure information, while others tend to be influenced by video streaming. For raw consumers only, individuals belonging to Classes 1 and 3 tend not to respond to the severity of the threat, as behavior is largely consistent across the standard and alternative video treatments, however consumers in Class 2 do seem to be influenced more by information reporting mortality, rather than morbidity risk.

Finally, again to provide additional insight to policy-based analyses, subgroup responses to the new FDA PHP mandate are not consistent. While the average consumer would reduce demand with the imposition of PHP-only oysters, only one class of all consumers, while two classes of raw consumers would behave in a similar manner. For the other subgroups, the policy would not alter their annual consumption. Other studies examining the role of technological innovation in food production can provide some background to understanding the variation in response across subgroups. Generally, this work indicates that consumer acceptance or rejection of food safety technology is driven by the perceived net benefits of the technology (Frewer, Howard, and Shepherd 1997; Hamstra and Smink 1996). For oysters, the net benefit of processing the product is a function of both the reduced risk and any perceived change in the aesthetic quality of the oyster (such as taste, smell, texture etc.). For the aesthetics, Otwell et al. (2011) conducted an oyster consumer sensory assessment of approximately 700 consumers. They find that consumers have a strong preference for traditional over PHP oysters, with the primary sensory attributes impacting preference being flavor and texture. For all consumers, we do not observe any change in behavior from two of the three subgroups due to the PHP mandate. We surmise that for these classes, the perceived benefit of risk reduction is offset by any perceived degradation in oyster quality from processing. Conversely, for raw consumers, for which there are actual morbidity and mortality risks, for two classes of consumer, it appears that the increase in risk perceptions outweigh the change in perceived quality, so demand falls. To illustrate the strength of feeling regarding paying a premium for processed oysters, all classes in both models would significantly reduce demand if the mandate caused an increase in price. As such, these results support those from the pooled model that the proposed FDA policy mandating PHP-only oysters would have detrimental effects on the oyster industry.

Conclusion

This research developed a revealed and stated preference (RP/SP) latent class modeling approach to account for heterogeneity in individuals' responses to health-risk information treatments and a recent FDA proposal for the use of food safety technology on oyster consumer behavior. Typically, RP/SP studies analyze the behavior of the average individual in the sample.

We posit that SP scenarios may affect individuals' preferences in different ways, so considerable information regarding the behavior of subgroups within the sample is not observed and interpretation of average responses in a traditional framework may be tenuous. For cases where potential preference heterogeneity is not observed by the researcher, a latent class analysis may demonstrate that behavioral responses to SP scenarios differ across classes of consumer. If so, policymakers may want to invest additional effort into examining how different population subgroups respond to the same policy treatment in order to understand the potential efficacy of treatments in altering behavior.

The modeling approach extends previous RP/SP research by developing a finite mixture, RP/SP model of subgroup behavior. As this research is policy-oriented, the model is appropriate as the classes are behavior based and so, are relevant to management and decision making (Swait 1994). The application to understanding consumers' responses to health-risk information treatments also enhances the food safety literature.

Results from the probabilistic model indicated that homogenous classes of consumers respond differently to the health-risk information treatments. For example, results from the standard pooled model indicate that the majority of brochure and standard video treatments raise individual risk perceptions and reduce demand for oyster meals. In particular, the existing brochure sourced to the ISSC reduces demand for oysters. Taken in this context, it would seem that the ISSC brochures, distributed under the 2001 *Vibrio vulnificus* Risk Management Plan for Oysters should have had an impact on reducing *v. vulnificus*-related illness and death rates. Accounting for heterogeneity in the data provides an insight to why the brochures have been ineffective. Results indicated that two classes of raw oyster consumers increase their demand for oysters following the ISSC-based information. Moreover, it highlights the potential need for future policy-based research to examine how different sample subgroups respond to the same policy treatment in order to understand the efficacy of treatments in altering behavior. We also observe that video streaming information is more influential than brochure treatments for certain population subgroups than others. Again from a policy perspective, understanding the most influential media form of risk information on behavior can play an important role in creating a more structured approach to information dissemination.

The FDA recently proposed a ban on traditional Gulf of Mexico oysters intended for the half-shell market during the months of April through October. Instead, only PHP oysters will be available. The proposed ban received a backlash of criticism from the oyster industry and interested stakeholders, with clear concerns over consumer acceptance of a treated oyster and the potential negative impacts on oyster demand. Findings from both the standard pooled RP/SP Poisson model and a LCA suggest that the proposed FDA ban will have a detrimental effect on the industry. With only PHP oysters available, the average oyster consumer will reduce demand for oysters even without an increase in price to reflect additional producer costs of production. Subgroup behavior is consistent with all consumer classes reducing oyster demand if there is a price premium associated with the processing technology. This result provides important feedback toward a FDA policy on treated oysters that is currently on hold pending research on consumers' acceptance of the product. As processing oysters will increase production costs, which will invariably be passed on to the consumer, the oyster industry will suffer from the negative economic effects of reduced consumer demand under the new FDA mandate.

References

Abraham, S.C.S., P. Sheeran, D. Abrams, and R. Spears. 1994. "Exploring Teenagers' Adaptive and Maladaptive Thinking in Relation to the Threat of HIV Infection." *Psychology and Health* 9:253-272

Ahluwalia, R., R.E. Burnkrant, and H.R. Unnava. 2000. "Consumer Response to Negative Publicity: The Moderating Role of Commitment". *Journal of Marketing Research* 37:203-214.

Anderson, J.G., and J.L. Anderson. 1991. "Seafood Quality: Issues for Consumer Researchers". *The Journal of Consumer Affairs* 25:144-163.

Bockstael N.E., and I.E. Strand. 1987. "The Effect of Common Sources of Regression Error on Benefit Estimates. *Land Economics* 13:11-20.

Brown, D.J., and L.F. Schrader. 1990. "Cholesterol Information and Shell Egg Consumption." *American Journal of Agricultural Economics* 72:548-555.

Earnhart, D. 2001. "Combining Revealed and Sated Preference Methods to Value Environmental Amenities at Residential Locations." *Land Economics* 77(1): 12-29.

Egan, K., and J. Herriges. 2006. "Multivariate Count Data Regression Models with Individual Panel Data From an On-Site Sample." *Journal of Environmental Economics and Management* 52(2):567-581.

Fox, J.A., D.J. Hayes, and J.F. Shogren. 2002. "Consumer Preferences for Food Irradiation: How Favorable and Unfavorable Descriptions Affect Preferences for Irradiated Pork in Experimental Auctions." *Journal of Risk and Uncertainty* 24(1):75-95.

Frewer, L.J., C. Howard, and R. Shepherd. 1997. "Public Concerns about General and Specific Applications of Genetic Engineering: Risk, Benefit, and Ethics". *Science, Technology, and Human Values* 22:98-124.

Haab, T., J.C. Whitehead, G.R. Parsons, and J. Price (2010). "Effects of Information about Invasive Species on Risk Perception and Seafood Demand by Gender and Race." *Resource and Energy Economics* 32(4): 586-599.

Hamstra, A.M., and C. Smink. 1996. Consumers and Biotechnology in the Netherlands. *British Food Journal* 98:34-38

Hausman, J., B.H. Hall, and Z. Griliches. 1984. "Econometric Models for Count Data with an Application to the Patents-R&D Relationship." *Econometrica* 52(4):909-938.

Huang, J.C., G.R. Parsons, P.J. Poor, and M.Q. Zhao. 2011. "Combined Conjoint-Travel Cost Demand Model for Measuring the Impact of Erosion and Erosion Control Programs on Beach Recreation." In: Whitehead JC, Haab T, Huang J-C (eds) Preference data for environmental valuation, 1st edn. Routledge, New York

Hynes, S., and W. Greene. 2013. A Panel Travel Cost Model Accounting for Endogenous Stratification and Truncation: A Latent Class Approach, Land Economics 89:177-192.

Krinsky, I., and A. Robb. 1986. “Estimating the Statistical Properties of Elasticities.” *Review of Economics and Statistics* 68:715-719.

Landry, C.E., and H. Liu. 2011. “Econometric Models for Joint Estimation of Revealed and Stated Preference Site-Frequency Recreation Demand Models, In: Whitehead J , Haab T, Huang J-C (eds) Preference Data for Environmental Valuation: Combining Revealed and Stated Approaches. Routledge, London.

Maddux, J.E., and R.W. Rogers. 1983. “Protection Motivation Theory and Self-Efficacy: A Revised Theory of Fear Appeals and Attitude Change. Journal of Experimental Social Psychology 19:242-253 .

McLachlan, G., and P. Peel. 2000. “Finite Mixture Models.” Wiley Series in Probability and Statistics.

Morgan, O.A., D.M. Massey, and W. Huth. 2009. “Diving Demand for Large Ship Artificial Reefs”. *Marine Resource Economics* 24(1): 43-59.

Morgan, O.A., G.S. Martin, and W.L. Huth. 2009. "Oyster Demand Adjustments to Alternative Consumer Education and Post-Harvest Treatments in Response to Vibrio vulnificus." *Journal of Agricultural and Applied Economics* 41(3): 683-696.

Morgan, O.A, J.C. Whitehead, W. Huth, G. Martin, and R. Sjolander. 2012. "A Split-Sample Revealed and Stated Preference Model to Examine Homogenous Subgroup Consumer Behavior Responses to Information and Food Safety Technology Treatments." *Working Paper*. Department of Economics, Appalachian State University.

Muth, M.K., J.E. Arsenault, J.C. Cajka, S.C. Cates, M.C. Coglaiti, S.A. Karns, M. O'Neil, and V Viator. 2011. "Analysis of How Post-Harvest Processing Technologies for Controlling Vibrio Vulnificus Can Be Implemented". Prepared for Food and Drug Administration, Center for Food Safety and Applied Nutrition, College Park, MD.

Otwell, S., L. Garrido, V. Garrido, and C. Sims. 2011. "Assessment Studies for Post-Harvest (PHP) Oysters: Part 1. Consumer and Expert Sensory Assessments." Report to the Interstate Shellfish and Sanitation Conference, Food Science and Nutrition Department, University of Florida.

Parsons, G.R., O.A. Morgan, J.C. Whitehead, and T.C. Haab. 2006. "The Welfare Effects of Pfiesteria-Related Fish Kills in Seafood Markets: A Contingent Behavior Analysis." *Agricultural and Resource Economic Review* 35:1-9

Scallan E., R.M. Hoekstra, F.J. Angulo, R.V. Tauxe, M. Widdowson, S.L. Roy, J.L. Jones, and P.M. Griffin. 2011. "Foodborne Illness Acquired in the United States – Major Pathogens." *Emerging Infectious Diseases* 17(1): 7-15.

Smith, E., E.O. van Ravenswaay, and S.R. Thompson. 1988. "Sales Loss Determination in Food Contamination Incidents: An Application to Milk Bans in Hawaii." *American Journal of Agricultural Economics* 70:513-520.

Swait, J. 1994. "A Structural Equation Model of Latent Segregation and Product Choice for Cross-sectional Revealed Preference Data." *Journal of Retailing and Consumer Services* 1(2): 77-89.

Swait, J. 1994. "A Structural Equation Model of Latent Segmentation and Product Choice for Cross-Sectional Revealed Preference Choice Data." *Journal of Retail and Consumer Science* 1(2): 77-89.

Swartz, D.G., and I.E. Strand. 1981. "Avoidance Costs Associated with Imperfect Information: The Case of Kepone." *Land Economics* 57:139-150.

Von Haefen, R.H. and D.J. Phaneuf. 2008. "Identifying Demand Parameters in The Presence of Unobservables: A Combined Revealed and Stated Preference Approach." *Journal of Environmental Economics and Management* 56(1):19-32.

Wessells, C.R., and J.G. Anderson. 1995. “Consumer Willingness to Pay For Seafood Safety Assurances.” *Journal of Consumer Affairs* 29:85-107.

Whitehead, J.C., T.C. Haab, J-C. Huang. 2000 “Measuring Recreation Benefits of Quality Improvements with Revealed and Stated Behavior Data.” *Resource and Energy Economics* 22:339-354.

Table 1 Seven SP Questions with Varying Informational Treatments

SP Question	Text
SP1: Expected meals consumed next year	Now we'd like to ask about the number of oyster meals you expect to eat **over the next 12 months**, starting from today. Thinking of the [NUMBER] oyster meals you told us that you typically eat in a year, if the average price of your oyster meals **stays the same**, do you think you will eat more, less, or the same number of oyster meals over the next year? *Then*, About how many more or less oyster meals do you expect to eat over the next year?
SP2 and SP3: Expected meals consumed next year with a price increase (decrease)	Oyster prices change over time. For example, if oyster harvests are large, prices go down. When oyster harvests are smaller, prices go up. Suppose the price of your portion of your typical oyster meal goes up (down) by [DOLLAR_UP] [(DOLLAR_DOWN)] but the prices of all other food products stay the same. Compared to the [NUMBER_SP1] oyster meals you said that you expect to eat over the next year, do you think you would eat more, less, or the same number of oyster meals over the next year with the higher (lower) price for each meal? *Then*, About how many more or less oyster meals do you expect to eat over the next year?
SP4: With brochure/video	Thinking about oyster meals again, suppose that the average price of your oyster meals stays the same. Compared to the [NUMBER_SP1] oyster meals you previously told us you expect to eat next year, do you think you will eat more, less, or about the same number of oyster meals in the next year, having read or watched the information from [INSERT SOURCE] on how you can reduce the risk from eating oysters? *Then*, About how many more or less oyster meals do you expect to eat over the next year?
SP5: News of illness and death	Thinking about oyster meals again, suppose that the average price of your oyster meals stays the same. Compared to the [NUMBER_SP4] oyster meals you previously told us you expect to eat next year, do you think you will eat more, less, or about the same number of oyster meals next year after learning about the recent illness and death reported in the article you just read? *Then*, About how many more or less oyster meals do you expect to eat over the next year?
SP6: PHP oysters	Suppose that the average price of your oyster meals stays the same. Compared to the [NUMBER_SP5] oyster meals you previously told us you expect to eat next year, do you think you will eat more, less, or about the same number of oyster meals next year **assuming that the only oysters available are those that have been Post-Harvest Processed**? *Then*, About how many more or less oyster meals do you expect to eat over the next year?
SP7: PHP Oysters with price premium	Continue to assume that the **only** oysters available are those that have been Post-Harvest Processed. Now suppose that the price of your portion of your average oyster meal using PHP oysters goes up by [DOLLAR_UP], but the prices of all other food products stay the same. Compared to the [NUMBER_SP6] oyster meals you previously told us you expect to eat next year, do you think you will eat more, less, or about the same number of oyster meals next year assuming that the only oysters available are those that have been Post-Harvest Processed? *Then*, About how many more or less oyster meals do you expect to eat over the next year?

Table 2 Descriptive Statistics

Variable	Description	Mean	Std. Dev.	Min	Max
Price	Price of oyster meal	0.80	2.11	-5.00	7.00
Quantity	Average annual oyster meals consumed	16.18	28.16	0.00	200.00
Age	Age of respondent	44.41	16.31	18.00	87.00
Gender	Respondent is male (=1)	0.49	0.50	0.00	1.00
Race	Respondent is Caucasian (=1)	0.77	0.42	0.00	1.00
Inc	Household income of respondent ($thousands)	69.04	38.38	8.00	150.00
SP	Stated preference question (=1)	0.88	0.33	0.00	1.00
At-risk	Consumer is immune-compromised (=1)	0.18	0.38	0.00	1.00
Sick	Chance of getting sick	1.57	1.14	0.00	5.00
Missick	Inputed missing chance of getting sick	0.03	0.16	0.00	1.00
Broc	Brochure with no source (=1)	0.05	0.21	0.00	1.00
BrocFDA	Brochure sourced to FDA (=1)	0.05	0.21	0.00	1.00
BrocISSC	Brochure sourced to ISSC (=1)	0.05	0.21	0.00	1.00
BrocASF	Brochure sourced to ASF (=1)	0.05	0.22	0.00	1.00
Vid	Video with no source (=1)	0.05	0.22	0.00	1.00
VidFDA	Video sourced to FDA (=1)	0.05	0.22	0.00	1.00
VidISSC	Video sourced to ISSC (=1)	0.05	0.22	0.00	1.00
VidASF	Video sourced to ASF (=1)	0.05	0.22	0.00	1.00
Alt	Alternative video with no source (=1)	0.03	0.18	0.00	1.00
AltFDA	Alternative video sourced to FDA (=1)	0.04	0.19	0.00	1.00
AltASF	Alternative video sourced to ASF (=1)	0.03	0.18	0.00	1.00
News_loc	News of local illness and death	0.18	0.39	0.00	1.00
News_Chi	News of non-local illness and death	0.12	0.32	0.00	1.00
PHP	Post-harvest processed oysters	0.25	0.43	0.00	1.00
PHP_Prem	Post-harvest processed oysters with price increase	0.50	1.54	0.00	7.00
FL	Respondent resides in Florida (=1)	0.18	0.39	0.00	1.00
GA	Respondent resides in Georgia (=1)	0.13	0.33	0.00	1.00
MS	Respondent resides in Mississippi (=1)	0.13	0.33	0.00	1.00
LA	Respondent resides in Louisiana (=1)	0.19	0.40	0.00	1.00
TX	Respondent resides in Texas (=1)	0.18	0.39	0.00	1.00
CA	Respondent resides in California (=1)	0.19	0.39	0.00	1.00

Sample size = 1,849 respondents

Table 3 Random Effects Poisson Demand Model

Variable	Coefficient	Standard Error	*p*-value
Constant	2.695	0.086	0.000
PRICE	-0.038	0.000	0.000
INCOME	0.001	0.001	0.006
WHITE	-0.422	0.053	0.000
MALE	0.324	0.043	0.000
AGE	0.000	0.001	0.879
SP	-0.020	0.003	0.000
AT-RISK	-0.219	0.058	0.000
SICK	-0.053	0.001	0.000
MISSICK	-0.048	0.019	0.012
BROC	-0.076	0.010	0.000
BROCFDA	-0.013	0.008	0.125
BROCISSC	-0.068	0.008	0.000
BROCASF	-0.053	0.009	0.000
VID	-0.006	0.009	0.467
VIDFDA	0.019	0.009	0.037
VIDISSC	-0.015	0.009	0.121
VIDASF	-0.044	0.008	0.000
ALT	0.022	0.011	0.038
ALTFDA	-0.011	0.011	0.326
ALTASF	0.026	0.010	0.001
NEWS_LOC	-0.063	0.013	0.000
NEWS_CHI	-0.025	0.014	0.071
PHP	-0.039	0.008	0.000
PHP_PREM	-0.035	0.001	0.000
FL	0.239	0.070	0.001
GA	0.247	0.077	0.002
MS	0.599	0.078	0.000
LA	0.657	0.073	0.000
TX	0.191	0.066	0.004
Alpha	1.265	0.045	0.000
Sample Size	1,849		
Periods	8		
Log likelihood	-48514.73		

Table 4 Statistics for Latent Class Model (All Consumers)

Number of Classes	Number of Parameters (P)	Log Likelihood at Convergence	AIC	BIC
2	30	-63915.0	-127890.0	-63802.2
3	30	-54833.2	-109726.4	-54720.4

Sample size is 14792 responses from 1849 individuals (N)
AIC (Akaike Information Criterion) = -2(LLB-*P*)
BIC (Bayesian Information Criterion) = -LLB + [(*P*/2)*ln(N)]

Table 5 Latent Class Demand Model – All Consumers

	Group1			Group2			Group3		
Variable	Coefficient	Std. Err.	*p*-value	Coefficient	Std. Err.	*p*-value	Coefficient	Std. Err.	*p*-value
Constant	3.666	0.006	0.000	1.237	0.017	0.000	2.358	0.010	0.000
PRICE	-0.037	0.001	0.000	-0.068	0.003	0.000	-0.048	0.001	0.000
INCOME	0.003	0.000	0.000	0.002	0.000	0.000	0.003	0.000	0.000
WHITE	-0.165	0.002	0.000	-0.243	0.006	0.000	-0.205	0.003	0.000
MALE	0.146	0.002	0.000	0.186	0.005	0.000	0.246	0.002	0.000
AGE	0.002	0.000	0.000	0.001	0.000	0.000	0.004	0.000	0.000
SP	-0.005	0.007	0.534	0.079	0.020	0.001	0.009	0.012	0.437
AT-RISK	-0.355	0.002	0.000	-0.288	0.008	0.000	-0.208	0.003	0.000
SICK	0.026	0.001	0.000	-0.115	0.003	0.000	-0.030	0.002	0.000
MISSICK	0.087	0.030	0.003	-0.259	0.099	0.009	-0.081	0.053	0.125
BROC	-0.097	0.012	0.000	0.124	0.053	0.020	-0.076	0.026	0.003
BROCFDA	0.107	0.012	0.000	0.010	0.0523	0.847	0.018	0.025	0.475
BROCISSC	0.428	0.011	0.000	-0.009	0.054	0.854	0.002	0.026	0.931
BROCASF	-0.068	0.013	0.000	-0.032	0.054	0.548	-0.039	0.026	0.123
VID	0.066	0.012	0.000	0.070	0.053	0.182	-0.058	0.025	0.021
VIDFDA	-0.064	0.012	0.000	-0.013	0.053	0.809	0.031	0.025	0.222
VIDISSC	-0.025	0.012	0.040	0.077	0.054	0.154	-0.007	0.026	0.787
VIDASF	-0.009	0.012	0.439	-0.194	0.054	0.000	-0.078	0.026	0.002
ALT	0.078	0.014	0.000	0.078	0.051	0.124	0.003	0.023	0.896
ALTFDA	-0.093	0.016	0.000	0.253	0.050	0.000	0.081	0.023	0.000
ALTASF	-0.319	0.016	0.000	-0.175	0.053	0.001	-0.029	0.023	0.215
NEWS_LOC	-0.006	0.019	0.765	-0.075	0.083	0.362	-0.034	0.037	0.363
NEWS_CHI	-0.101	0.019	0.000	-0.088	0.083	0.292	0.043	0.037	0.249
PHP	-0.002	0.016	0.904	-0.066	0.061	0.282	-0.046	0.024	0.051
PHP_PREM	-0.032	0.002	0.000	-0.037	0.007	0.000	-0.027	0.003	0.000
FL	-0.097	0.002	0.000	0.101	0.008	0.000	-0.003	0.004	0.520
GA	-0.251	0.003	0.000	-0.108	0.009	0.000	-0.197	0.005	0.000
MS	0.006	0.002	0.054	0.224	0.009	0.000	0.157	0.004	0.000
LA	0.089	0.003	0.000	0.345	0.007	0.000	0.190	0.004	0.000
TX	0.045	0.003	0.000	0.077	0.008	0.000	0.066	0.004	0.000
Constant	-6.244	0.108	0.000	-3.794	0.068	0.000	-3.639	0.056	0.000
Class Prob	0.132			0.512			0.356		

Table 6 Latent Class Demand Model – Raw Consumers Only

	Group1			Group2			Group3		
Variable	Coefficient	Std. Err.	*p*-value	Coefficient	Std. Err.	*p*-value	Coefficient	Std. Err.	*p*-value
Constant	3.202	0.012	0.000	0.370	0.052	0.000	1.739	0.020	0.000
PRICE	-0.033	0.002	0.000	-0.068	0.011	0.000	-0.038	0.003	0.000
INCOME	0.003	0.000	0.000	0.006	0.000	0.000	0.004	0.000	0.000
WHITE	0.182	0.003	0.000	-0.074	0.017	0.000	-0.086	0.001	0.000
MALE	-0.115	0.003	0.000	0.126	0.013	0.000	0.012	0.005	0.012
AGE	0.004	0.000	0.000	-0.002	0.000	0.000	0.001	0.000	0.000
SP	0.023	0.022	0.303	0.067	0.109	0.540	0.152	0.037	0.000
AT-RISK	-0.788	0.005	0.000	-0.801	0.028	0.000	-0.476	0.008	0.000
SICK	0.025	0.001	0.000	0.021	0.010	0.028	-0.035	0.003	0.000
MISSICK	0.110	0.022	0.000	0.102	0.094	0.278	0.111	0.039	0.004
BROC	0.174	0.020	0.000	0.042	0.115	0.714	0.004	0.034	0.906
BROCFDA	0.100	0.018	0.000	0.022	0.116	0.846	0.211	0.034	0.000
BROCISSC	0.299	0.017	0.000	0.059	0.116	0.611	0.235	0.034	0.000
BROCASF	-0.271	0.019	0.000	-0.328	0.115	0.004	-0.194	0.034	0.000
VID	0.014	0.018	0.439	-0.164	0.121	0.176	-0.292	0.034	0.000
VIDFDA	-0.174	0.018	0.000	-0.161	0.115	0.168	-0.096	0.037	0.009
VIDISSC	0.115	0.018	0.000	-0.220	0.118	0.062	-0.055	0.035	0.119
VIDASF	-0.291	0.020	0.000	-0.060	0.115	0.600	0.046	0.034	0.177
ALT	0.505	0.017	0.000	0.276	0.119	0.021	0.066	0.035	0.060
ALTFDA	-0.434	0.020	0.000	-0.374	0.123	0.002	-0.447	0.040	0.000
ALTASF	0.491	0.018	0.000	0.135	0.125	0.279	0.069	0.036	0.055
NEWS_LOC	-0.083	0.015	0.000	-0.072	0.080	0.366	0.012	0.030	0.678
NEWS_CHI	0.001	0.016	0.956	0.043	0.084	0.612	0.053	0.031	0.080
PHP	-0.001	0.015	0.938	-0.233	0.076	0.002	-0.097	0.025	0.000
PHP_PREM	-0.038	0.003	0.000	-0.050	0.019	0.009	-0.024	0.006	0.000
FL	-0.534	0.005	0.000	-0.623	0.028	0.000	-0.227	0.009	0.000
GA	0.665	0.004	0.000	0.241	0.020	0.000	0.539	0.007	0.000
MS	-0.353	0.005	0.000	-0.841	0.027	0.000	-0.129	0.008	0.000
LA	-0.081	0.005	0.000	-0.234	0.022	0.000	0.003	0.007	0.662
TX	-0.058	0.004	0.000	-0.058	0.021	0.006	0.081	0.007	0.000
Constant	-2.189	0.062	0.000	-0.115	0.016	0.000	-2.365	0.040	0.000
Class Prob	0.099			0.655			0.246		

Appendix A Data Sources

All data are derived from an online survey, conducted by Online Survey Solutions, of oyster consumers in March and April, 2010. The research was supported by Gulf Oyster Industry Program Grant No. R/LR-Q-32