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Willingness-to-Pay for Oyster Consumption Health Risk Reductions

Abstract. In this paper we use data from an internet-based survey and estimate the benefits of an oyster consumption safety policy with the contingent valuation method. In addition to providing a context specific estimate of willingness-to-pay for oyster safety, we consider two unresolved issues in the contingent valuation health risk literature. First, a number of studies in the mortality risk reduction literature find that willingness-to-pay is not sensitive to the scope of the risk change. We present the scope test as a difference in the number of lives saved by the program, instead of small changes in risk, and that referendum votes are responsive to scope. Second, we identify those at risk respondents who would actually benefit from the policy and decompose willingness-to-pay into personal mortality risk reduction values and altruistic willingness-to-pay. We find that respondents are sensitive to the scope of the policy and most at-risk respondents are willing to pay even more. We find that willingness-to-pay per life saved is $1.28 million for the pure private good of own-risk reduction. Willingness-to-per per life saved including private values and public, altruistic nonuse values is $5.92 million. Altruistic values are the major component of willingness-to-pay.

Key words: contingent valuation, scope test, altruism, seafood safety, health risk, oyster

1. Introduction

The oyster is an economically important commercial fish species. Between 2001 and 2010 landings of the eastern oyster ranged from 16 million to 27 million pounds in the Gulf of Mexico. Ex-vessel revenue ranged from $61 million to $75 million ($2010), about 10% of total ex-vessel revenue generated by Gulf of Mexico fisheries (personal communication, National Marine Fisheries Service). Considering that a 100 pound sack contains about 250 oysters and the average oyster meal contains about 6 oysters, consumers enjoy about 9.3 million Gulf of Mexico oyster meals annually. Considering that oyster meals generate consumer surplus of about $11 per meal (Morgan, Martin and Huth 2005), the annual value of Gulf of Mexico oyster meals to consumers is about $100 million.

Oyster consumers are at risk from the *Vibrio vulnificus* bacteria. *Vibrio* is found naturally in U.S. coastal waters although it is most widespread in the warm waters of the Gulf of Mexico during the summer months. *Vibrio* can be transmitted to humans through the consumption of raw shellfish harvested from waters containing the organism. The ingestion of the *Vibrio* bacteria typically poses little risk of illness when consumed by a healthy adult with a normally functioning immune system. However, a small percentage of the oyster consumer population are immunocompromised (such as those with chronic liver disease, cancer, or HIV/AIDS) and at a greater risk for contracting infections from oyster consumption. The risk of life threatening illness from consuming oysters arises primarily if the oysters are consumed raw or undercooked.

According to the International Shellfish Sanitation Conference[1], the Food and Drug Administration (FDA) recorded 341 *Vibrio*-related serious illnesses between 1989 and 2002. Over 98 percent of these were associated with consuming raw oysters, of which 179 resulted in death. At an average annual rate, approximately 30 consumers become seriously ill from consuming raw Gulf oysters, of which 15 die. More recently, Scallon et al. (2011) find that *Vibrio* ranks as the fourth leading cause of foodborne pathogen death with 36 estimated annual deaths. Of the 31 food-borne pathogens considered the 35 percent *Vibrio* death rate is highest.

Oyster processing is regulated by the FDA under the National Shellfish Sanitation Program (NSSP) and the Interstate Shellfish Sanitation Program (ISSC). Over the last decade, in conjunction with the ISSC, the FDA has educated at-risk consumers via disseminating *V. vulnificus* fact sheets or brochures detailing the risks associated with raw oyster consumption. Despite this, the frequency of *Vibrio vulnificus* illness at the national level remained constant. With the ineffective education strategies, the FDA and ISSC mandated that states implement controls to reduce the incidence of *Vibrio vulnificus* illness. These plans, included in the NSSP, focused primarily on encouraging the use of post-harvest processing (PHP) technologies for reducing *V. vulnificus* bacteria levels. There are four FDA-approved oyster processing methods that may be used to reduce bacteria in oysters to non-detectable levels: irradiation, individual quick-freezing, cool pasteurization, and hydrostatic pressure.

In October 2009, disappointed with the progress being made under the NSSP, the FDA announced a controversial reformulation of its policy, requiring only the use of PHP Gulf oysters

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[1] http://www.issc.org/client_resources/Education/English_Vv_Risk.pdf

for the raw half-shell market during the months of April through October, with an effective date of May 2011. Beyond the initial unease from the ISSC and industry representatives about the FDA's unilateral decision, industry concern surrounded consumers' acceptance of a treated oyster product and the potential negative impact on the oyster industry. Based on these concerns, the FDA has since issued a letter postponing implementation until additional research into the consequences of such a ban could be completed.

In this paper we use data from an internet-based survey and estimate the benefits of the PHP policy with the contingent valuation method. In the next section we review the food safety and mortality risk reduction contingent valuation literature. We then describe some theory, our survey methods, data, empirical models and empirical results. Conclusions and a brief comparison of the benefits and costs of the policy follow.

2. Literature

The food safety literature includes a large number of studies related to pesticide risk (Florax, Travisi and Nijkamp 2005). There are relatively fewer studies that examine seafood safety (e.g, Wessels, Kline and Anderson 1996; Huang, Haab and Whitehead 2004; Parsons, Morgan, Whitehead and Haab 2006). There are fewer still that focus on oyster consumption.

Three oyster consumption studies use revealed preference data. Lin and Milon (1993) use survey data on individual consumption and find that safety perceptions are not important in oyster consumption decisions. Responses to new health information, in the form of a television program that aired during the survey period, were most important in affecting the amount of oysters consumed, but not whether the respondent would participate in the market. Keithly and Diop (2001) estimate the effects of mandatory warning labels for Gulf oysters using aggregate annual data on landings and ex-vessel revenues. They find an immediate negative impact on demand price that incompletely dissipates with time. Using this estimate for consumer surplus losses, an estimate of the value of statistical life from the labor market literature and cost inferences from ex-vessel revenue, they argue that the benefits of a ban on Gulf oysters from April to October exceed the costs. More recently, Bruner et al. (2011) conduct experiments and consider the effects of taste and risk information on willingness-to-pay for raw oysters. They find that relatively uninformed consumers are willing to pay equivalent amounts for PHP and traditional raw oysters. After a blind taste test consumers are willing to pay less for PHP oysters even after information on relative risk is provided.[2]

Three papers use stated preference data to estimate the benefits of safe oysters. Lin and Milon (1995) use the contingent valuation method to estimate the willingness-to-pay for a reduction in the health risk of eating oysters. They find that willingness-to-pay is not sensitive to the scope of the policy. Morgan, Martin and Huth (2005) use contingent behavior data to estimate the effects of information about oyster consumption health risks. They find that cooked and raw oyster consumers behave differently following information about an oyster-related death with raw oyster consumers increase consumption. Counter safety information from

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[2] Otwell et al. (2011) conducted a 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.

nongovernmental organizations is more effective in mitigating risk than information from government agencies. Morgan et al. (forthcoming) use both revealed and stated preference demand data and find that oyster demand falls with the PHP policy and educational information treatments cause vulnerable at-risk consumers to further reduce their oyster demand.

While *Vibrio* ranks as the fourth leading cause of foodborne pathogen death, to date, no study has effectively estimated the willingness-to-pay for specific reductions in health risk from oyster consumption. Oyster safety policy analysis must rely on benefit transfer of willingness-to-pay estimates from other literatures (e.g., Keithly and Diop). A number of studies have found that willingness-to-pay can vary across the source of health risk (Kenkel 2003). Dekker et al. (2011), in a meta-analysis of stated preference studies, find that road safety and air pollution studies generate significantly different estimates of the value of risk reduction. Kochi, Hubbell and Kramer (2006) compare 31 hedonic wage studies that consider job risk and 14 contingent valuation studies that consider various forms of risk. They find that the willingness-to-pay for reductions in mortality risk are significantly lower when estimated with contingent valuation. Viscusi (2012) sees this difference arising from differences in actual and hypothetical risk change. Hedonic wage studies address real risks while stated preference studies address hypothetical risk. Nevertheless, these studies raise the question of whether existing oyster safety policy analyses have accurately compared benefits and costs.

In addition to providing a context specific estimate of the willingness-to-pay for oyster health risk reductions, we consider two unresolved issues in the contingent valuation mortality risk reduction literature. First, a number of studies in the mortality risk reduction literature find that willingness-to-pay is not sensitive to the scope of the risk change (e.g., Hammitt and Graham 1999, Goldberg and Roosen 2007, Sund 2009). This result is not conclusive, for example, Lindhjem et al. (2011) conduct a meta-analysis of stated preference studies and find that willingness-to-pay is sensitive to the magnitude of the health risk. Recommendations for this problem include using visual aids to more effectively communicate risk (Corso, Hammitt and Graham 2001) and controlling for attitudes and experience (Leiter and Pruckner 2009). However, one problem is that survey respondents have difficulty understanding small changes in probabilities regardless of how they are presented.

Another valuation strategy is to change the format of the valuation question. Instead of asking respondents about changes in small probabilities, Bateman and Brouwer (2006) present respondents with a willingness-to-pay question that avoids quantitative measures of health risks. They find that willingness-to-pay for risks to family health is greater than the willingness-to-pay for risks to individual health. Bosworth, Cameron and DeShazo (2009) present deaths avoided as a randomly assigned policy specific variable in a choice experiment and find that willingness-to-pay varies over deaths. Similarly, in this paper we ask respondents about their willingness-to-pay for lives saved, without requiring an understanding of small probabilities.

A number of studies have addressed the theoretical aspects of altruism and benefit-cost analysis and argue that willingness-to-pay that includes altruism towards others should not necessarily be included in benefit-cost analysis (Jones-Lee 1991, Bergstrom 2006). Flores (2002) provides a contrasting view. To illustrate the issue, Johannesson, Johansson and O'Conor (1996) present two groups of respondents with different traffic safety programs. The private program protects only the occupants of the respondent's car while the public program protects everyone on the road. Both programs have the same risk reduction and, a priori, paternalistic altruistic preferences would lead to a greater willingness-to-pay for the public program. They find that willingness-to-pay for the public program is less than the private program, suggesting a nonpaternalistic altruistic concern about the costs of the program. Lindhjem et al. (2011) include a public variable in their meta-analysis, where public equals one if the risk change is public and zero if the risk change is only for the individual or household. They find that willingness-to-pay for public programs is lower than for private programs. These results make it difficult to isolate the willingness-to-pay for mortality risk reductions for public programs. In this paper we are able to (1) identify those at risk respondents who would individually benefit and (2) isolate the costs for those who would benefit from the policy and distinguish between public (i.e., altruistic and own health risk) and private (i.e., own health risk) values.

3. Theoretical Model

In this section we develop a simple theoretical model that will be used to guide the empirical analysis. Consider the indirect utility function that depends on income and nonmarket goods, $v(p, q, r, h, m)$, where p is the oyster meal price, q is oyster quality (i.e., taste and texture), r is the individual risk of illness and death, h is the health status of others and m is income, where $\partial v/\partial p < 0$, $\partial v/\partial q > 0$, $\partial v/\partial r < 0$, $\partial v/\partial h > 0$, and $\partial v/\partial m > 0$.Willingness-to-pay for the PHP oyster program, *WTP*, is the dollar amount taken away from income that leaves the individual no worse off than if they did not enjoy the PHP program

$$(1) \qquad v(p,q,r,h,m) = v(p',q',r',h',m-WTP)$$

where $p < p'$ is the increase in oyster price, $q > q'$ is the decrease in oyster quality, $r > r'$ is the change in the individual risk of illness and death (an improvement), and $h < h'$ is the change in the health status of others (an improvement) that would result from the PHP program.[3]

Willingness-to-pay can also be expressed as the difference in expenditure functions

$$(2) \qquad WTP = e(p,q,r,h,u) - e(p',q',r',h',u)$$

Substituting the indirect utility function into (2) yields

$$(3) \qquad WTP = m - e(p',q',r',h',v(p,q,r,h,m))$$

Comparative static properties of the willingness-to-pay function can be used to develop tests for the theoretical validity of *WTP* (McConnell, 1990, Whitehead, 1995).

The effect of the price increase, holding the baseline price constant, on willingness-to-pay is, $\frac{\partial WTP}{\partial p'} = -\frac{\partial e}{\partial p'} = -x(p') < 0$, where $x(p')$ is the compensated demand for oysters at the post-policy price. Since expenditures necessary to maintain constant utility increase with the price change, the effect of the price change on willingness-to-pay is negative. Willingness-to-pay is

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[3] If negative value of the quality change exceeds the positive value of the risk and health change then willingness-to-pay will be negative.

increasing in the oyster quality change, $\frac{\partial WTP}{\partial q'} = -\frac{\partial e}{\partial q'} = x(q') > 0$, where $x(q')$ is the compensated demand, or marginal willingness-to-pay, for oyster quality. Decreases in quality increase the expenditures necessary to reach the baseline utility level.

Willingness-to-pay is decreasing in the risk change, $\frac{\partial WTP}{\partial r'} = -\frac{\partial e}{\partial r'} = -x(r') < 0$, where $x(r')$ is the compensated demand, or marginal willingness-to-pay, for individual health risk. Since the individual risk of illness and death is a bad, a larger risk change (i.e., a decreasing *r'*) will decrease the expenditures necessary to achieve the reference level of utility. For altruistic respondents, willingness-to-pay is increasing in the health status of others, $\frac{\partial WTP}{\partial h'} = -\frac{\partial e}{\partial h'} > 0$, since an increase decreases the expenditures necessary to reach the baseline utility.

The effect of income on willingness-to-pay is indeterminate, $\frac{\partial WTP}{\partial m} = 1 - \frac{\partial e(')}{\partial v} \Big/ \frac{\partial e(.)}{\partial v} \gtreqless 0$, where the marginal cost of utility, $\frac{\partial e}{\partial v}$, is equal to the inverse of the marginal utility of income, $\frac{\partial v}{\partial m}$. If the policy is a normal good the marginal cost of utility will be greater with the status quo and the income effect will be positive. If the policy is an inferior good the income effect will be negative. If the policy is unrelated to income or if the marginal utility of income is constant the income effect will be zero.

4. Survey Sample

We developed an internet survey of oyster consumers (aged 18 and over), sampled from the U.S. Center for Disease Control-designated “case states” in which there are documented cases of *V. vulnificus*-related deaths. These are Florida, Alabama, Mississippi, Louisiana, Texas, and California. Due to a request from Georgia Sea Grant Program, consumers from Georgia were also sampled. The sample was drawn from a panel of online respondents maintained by Online Survey Solutions, Inc. (OSS) and the survey was administered between March and April, 2010[4]. The response rate was 53 percent.

Due to the low incidence rate of oyster consumption in the general population, and the lack of any known data base of oyster consumers, we relied on several screening questions to select a representative sample. Potential respondents in our panel were first screened on selected demographic variables (residence location, age and gender) in order to fill quotas based on population size and age and gender proportions in the targeted geographic areas. Those accepted by these demographic screeners were then asked a second screening question to determine if they had ever eaten oysters. Those who indicated that they currently consume oysters make up the sample used in the current study. In total, there were 1849 completed responses from oyster consumers across the seven states.

Demographics of this sample, when compared to geographical area baselines, are generally similar, though they do differ in some key respects. Part of this difference is attributable to differences in population access to and use of the internet as in all online samples, while there are also effects that may be due to differences in those who comprise the consumer market for oysters from the population as a whole. Current oyster consumers tend to have higher levels of educational attainment and higher incomes than non-consumers. Current oyster

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

consumers tend to include fewer minorities. The gender balance of current consumers is similar to the population as a whole. Finally, our sample of current oyster consumers includes slightly more individuals aged 65 and over than the population as a whole.

The issue of whether the reported raw oyster consumption rate (38 percent[5]) and "at-risk" rate (18 percent) is representative of rates in the population of current oyster consumers is difficult to answer definitively. A recent study reported a 68 percent rate of raw consumption among current oyster consumers in coastal California, Florida, Louisiana and coastal Texas (ORC MACRO 2004). The mean age of raw consumers in the current study and the ORC MACRO study are comparable (43 and 44, respectively) as are gender (male, 56 percent and 53 percent) and race (white, 70 percent and 73 percent). Similarly, we can compare at-risk rates between the ORC MACRO study and the current study. In 2004, the authors reported a 15 percent at-risk rate based on the incidence of liver disease, diabetes and/or a weakened immune system. Our rate of 18 percent is somewhat higher, but we added (based on newer medical standards) the additional qualifiers of cancer (including lymphoma, leukemia, or Hodgkin's Disease), a stomach disorder, and iron overload disease (hemochromatosis).

5. Survey Design

The survey had two major parts[6]. First, respondents were asked general questions about attitudes, preferences, awareness and perceptions of oyster consumption health risk. Second,

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[5] Sixty-three percent of respondents state that their future meals will include raw oysters.

[6] The full survey is available upon request from the authors.

respondents were asked a series of hypothetical questions regarding their annual oyster consumption based on current conditions and under alternative information treatments and willingness-to-pay questions for the PHP policies.

Before a series of hypothetical future, or stated preference, demand elicitation questions, respondents were asked about their past, or revealed preference, annual consumption frequency to generate pretreatment baseline data. To aid the respondent in determining the annual amount, they were asked how many months in a year that they typically consumed an oyster meal, and then, in a typical month in which they ate oyster meals, about how many oyster meals did they eat. Respondents were then asked a series of five stated preference questions to elicit their annual number of oyster meals consumed under various hypothetical scenarios. The first stated preference question asked respondents whether, compared to the number of meals they revealed they consume in a typical year, did they expect to eat more, less, or the same number of oyster meals next year? They were then prompted to state how many more or less.

After each stated preference question, respondents were given a follow-up question asking them to state their perceived chances of getting sick from eating these meals. The perceived health question is "Now, considering the [*x*] oyster meals you expect to eat over the next year, what do you think your chances are of getting sick from eating these meals? Do you think your chances of getting sick are not likely at all, somewhat unlikely, somewhat likely or very likely?" where [*x*] is the number of oyster meals the respondent thinks they will eat in various situations. Respondents were prompted to choose from a five-level Likert scale of "Not very likely at all; Somewhat not likely; Somewhat likely; Very likely; I don't know." Responses are coded as 1 if the chance of getting sick is not likely at all, 2 if somewhat not likely, 3 if unsure, 4 if somewhat likely and 5 if very likely.

To derive the oyster demand curve for the sample, respondents were presented with price increase and price decrease scenarios (while the price of all other food products remained the same), where price changes were varied randomly across respondents. Price increases were varied randomly across respondents as \$1, \$3, \$5 or \$7. Price decreases were varied randomly across respondents as \$1, \$2, \$3 or \$4. Respondents were then randomly assigned and presented with either a *V. vulnificus* facts brochure or a *V. vulnificus* informational video. The source of which was varied randomly between no source, the FDA, the ISSC, or a not-for-profit American Shellfish Foundation. Next, respondents read a fictitious newspaper article regarding a recent consumer illness and death associated with eating raw oysters. The article was based on actual newspaper reports of *V. vulnificus*-related human illnesses and fatalities. Stated preference annual oyster meal and expected sickness questions followed each of these scenarios.

Prior to the next stated preference expected oyster meal question, respondents were presented textual material on PHP treated oysters. The material informed respondents that there are currently four FDA-approved PHP methods, all of which reduce *V. vulnificus* to non-detectable levels. A stated preference question then elicited respondents' annual oyster meal count having read about PHP and assuming that the only oysters available are those that have been post-harvest processed. To further examine whether respondents would pay a premium for PHP oysters that eliminate the risk of death from consuming raw oysters, we asked the same stated preference question on expected annual oyster meals consumed but with an increase in price. Price premiums were varied randomly across respondents as $1, $3, $5 or $7.

The stated preference section included three contingent valuation questions. Each willingness-to-pay question is in the referendum format:

> "Suppose that in order to minimize the risks from eating raw oysters, the U.S. Food and Drug Administration (FDA) proposes a federal law to ensure that all oysters are post-harvest processed (PHP) before going to market. It is believed that this will reduce the average annual number of deaths in the U.S. from eating raw oysters from the current 16 to 20 people to [*D*] people. However, because of the additional costs incurred by oyster producers to process their product, the program will result in an increase in the price of an average oyster meal for all consumers. Imagine that you have the opportunity to vote on this proposed law. If more than 50% of those vote for the federal law, the FDA would put it into practice. If you could vote today and you knew that the price of your average oyster meal would go up by [*bid*] but the price of all other food would stay the same, would you vote for or against the proposed law?"

There are three randomly assigned versions of the annual deaths [*D*], 1 to 5, 6 to 10 and 11 to 15, and four randomly assigned bid levels, $1, $3, $5 and $7. Each respondent received the same price increase as received in the related contingent behavior question. Respondents were given three choice options, for, against and undecided (would not vote).

Those respondents who voted for the policy were asked a follow-up certainty question:

“How sure are you about your choice to vote for the proposed law?” The possible answers were not sure at all, not very sure, somewhat sure and very sure. Those respondents who voted against or were undecided were presented with a second referendum question that increased the benefit of the policy: “Now suppose that the proposed post-harvest processing law could reduce illness and the number of deaths to 0 (zero). Would you vote For or Against the proposed law?” Respondents who voted against the second referendum or were undecided were asked a third referendum question: “Now suppose that instead of applying to all oysters the proposed post-harvest processing law only applied to those oysters intended to be eaten raw during the period from April 1 through October 31 when risk of infection is higher. Would you vote For or Against the proposed law?”

6. Data

The theoretical model suggests that willingness-to-pay depends on the post-policy oyster price and oyster quality. We are unable to directly recover these effects in our empirical analysis. As described in the empirical model section below, the variation in the post-policy price change in the hypothetical scenario is embedded in the willingness-to-pay per meal estimate. Our measure of oyster quality perceptions suffers from low sample size. Respondents were asked follow-up questions to determine if they had ever eaten PHP oysters and if they thought processed and unprocessed raw oysters tasted the same. Only about one-half of the 8 percent of respondents who knew that they had eaten PHP oysters agreed with a statement that they taste the same as unprocessed oysters. Since each of these variables affects oyster consumption we conduct our analysis with two sub-samples of respondents in order to mitigate against omitted variable bias: (1) those who state that they will decrease oyster consumption after the PHP policy and (2) those who would not decrease oyster consumption after the policy.

Overall, the average number of revealed preference (RP) annual oyster meals is 19 with almost 4 of these consumed raw. The average number of stated preference (SP) annual oyster meals is 17 with almost 8 consumed raw. With the PHP policy average oyster meal consumption falls to 15 with almost 6 consumed raw. These full sample results mask significant variation in the sample (Table 1). Considering the SP scenarios, 76 percent of the full sample would either increase (n=82) or maintain (n=1318) oyster consumption with the PHP policy. With the PHP policy average cooked oyster meal consumption increases by almost one meal with only a slight decrease in raw meals consumed. For those oyster consumers who would decrease consumption with the PHP policy, cooked meals fall by 45 percent and raw meals fall by 76 percent.

A summary of the first referendum vote variables is presented in Table 2. For those respondents who would not reduce oyster consumption with the PHP policy, thirty three percent would vote for the policy, 30 percent are undecided and 38 percent would vote against. The "for" votes fall from 43 percent to 26 percent as the oyster meal price increase rises from $1 to $7. The votes vary significantly across the three alternatives with the price increase (χ^2= 27.08 [df=6], p=0.01). For those respondents who reduce oyster consumption with the PHP policy, thirty nine percent would vote for the policy, 27 percent are undecided and 34 percent would vote against. The votes significantly vary across the three alternatives with the price increase (χ^2= 15.22 [df=6], p=0.05). The Cochran-Mantel-Haenszel nonzero correlation statistic comparing votes across subsamples holding the price change constant indicates no statistically significant difference (χ^2= 3.82 [df=1], p=0.10).

A significant number of respondents vote “for” the policy when they are told that the number of deaths could be reduced to zero and the PHP policy would only be in effect from April to November. For those who would not decrease consumption, 36 percent of those who were uncertain or voted “against” in the first referendum (n = 940) voted “for” in the second (i.e., zero deaths) referendum. Eighteen percent of those still uncertain or against (n = 599) voted “for” in the third (i.e., April – November) referendum. Considering all three votes, 65 percent of this subsample votes for the PHP policy. For those who would decrease consumption, 42 percent of those who were uncertain or voted “against” in the first referendum (n = 271) voted “for” in the second referendum. Seventeen percent of those still uncertain or against (n = 156) voted “for” in the third referendum. Overall, 74 percent of this subsample votes for the PHP policy.

A summary of the independent variables by subsample is presented in Table 3. The average increase in the price of an oyster meal is $4 and the average number of lives saved by the policy described in the first scenario is 10. The average age of the full sample is 44 (n=1849). Forty nine percent of the sample is male and 77 percent is white. The average number of years of schooling is 15, average household size is 2.61 and the average number of children is 0.55. The average income is $62,000. Eighteen percent of respondents have health conditions that make oyster consumption risky. Thirty eight percent of the sample eats raw oysters. These last two variables are used to identify those respondents who face an individual risk of death.

Tests for differences in means for continuous variables across each subsample indicate no differences in the number of children. Household size is significantly lower (t=2.79) in the non-negative consumption sample. Household income (t=2.25), age (t= 3.80) and education (t=2.88) are significantly higher in the non-negative consumption sample. For the dummy variables we conduct likelihood ratio tests for equality. Respondents who think they are more likely to get sick after eating PHP oysters (χ^2=115.90[1 df]) and California residents (χ^2=3.00[1 df]) are more likely to be in the negative consumption sample. Respondents who are male (χ^2=22.94[1 df]), white (χ^2=24.46[1 df]), and Louisiana residents (χ^2=12.98[1 df]) are more likely to be in the non-negative consumption sample.

7. Empirical Model

In this section we describe the empirical model to estimate the value of the PHP oyster policy with the referendum format of the contingent valuation method. Conceptually, the categorical response, y_i, to the referendum valuation question depends on whether willingness-to-pay is greater than the price change amount. Since there are a large number of voters who are unsure about their vote, we use an ordered model with the "undecided" or "would not vote" alternative as a middle response:

$$(4) \qquad y_i = \begin{cases} 0 & if\ WTP_i - \delta_i > dP \\ 1 & if\ WTP_i \pm \delta_i \overset{>}{\underset{<}{-}} dP \\ 2 & if\ WTP_i + \delta_i < dP \end{cases}$$

where $\delta_i \geq 0$ is a term that represents respondent uncertainty about their willingness-to-pay and $i = 1, \ldots, n$ respondents. Respondents will vote for or against the policy in the referendum if the magnitude of their uncertainty about willingness-to-pay is insufficient to affect the relationship between the certain willingness-to-pay and the price change. If the resolution of the uncertainty could change respondent welfare after the vote, then respondents will be uncertain and vote accordingly.

Since we have pseudo-panel data, from one to three referendum votes for each respondent, we estimate a "censored" panel ordered probit, where $WTP_{it} + \delta_{it} = \beta' x_{it}$, $t = 1, \ldots, T_i$

$$
\begin{aligned}
\Pr(y_i) &= \Pr(WTP_{it} + \delta_{it} \geq dP) \\
&= \Pr\left(\beta' x_{it} + e_{it} \geq dP\right) \\
&= \Pr\left(\frac{\beta' x_{it} - dP}{\theta} \geq \frac{e_{it}}{\theta}\right) \\
&= \Phi\left(\frac{\beta' x_{it} - dP}{\theta}\right)
\end{aligned} \tag{5}
$$

where x_i is a vector of independent variables and a constant, $-1/\theta$ is the coefficient on the price amount (Cameron and James 1987).

The ordered probit model estimates thresholds for the latent dependent variable

$$
y_i = \begin{cases} 0 & if\ y_i^* < \mu_0 \\ 1 & if\ \mu_0 < y_i^* \leq \mu_1 \\ 2 & if\ y_i^* > \mu_1 \end{cases} \tag{6}
$$

If $\mu_0 = 0$, as normalized in the LIMDEP statistical software (Greene, 2007), then μ_1 allows direct estimation of δ and the bounds of uncertainty on willingness-to-pay (Groothuis and Whitehead 1992). Since the price amount is varied across respondents, θ can be identified and the lower bound mean willingness-to-pay is

(7) $$WTP = \theta(\beta'\bar{x})$$

where $\bar{x}$ is the mean of the independent variables (Cameron and James 1987). The lower bound is the willingness-to-pay amount arising if all undecided voters decide to vote "against" in the referendum. The upper bound mean willingness-to-pay is

(8) $$WTP = \theta(\mu_1 + \beta'\bar{x})$$

The upper bound is the amount that would arise if all undecided voters decide to vote "for" in the referendum.

We estimate two equivalent versions of the panel model (Greene and Hensher, 2010). The random effects model decomposes the error term into two components, $e_{it} = \varepsilon_{it} + u_i$, where ε_{it} is the random error term and u_i is an individual specific error term, $\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2 = 1)$, $u_i \sim N(0, \sigma_u^2)$. Since $\rho = \frac{\sigma_u^2}{\sigma_\varepsilon^2 + \sigma_u^2}$ and $\sigma_\varepsilon^2 = 1$, $\sigma_u^2 = \frac{\rho}{1-\rho}$ and a test for the significance of the individual specific error term is a t-test for the positive correlation across responses, $\rho = 0$. The random parameters model uses maximum simulated likelihood to estimate both mean and standard deviations for the ordered probit regression coefficients, $\beta_i = \beta + \omega_i$, where β is the mean of the coefficient and ω_i is a randomly distributed term. We specify random parameters in the constant only to estimate a model equivalent to the random effects model and allow heterogeneity in mean willingness-to-pay[7].

8. Empirical Results

The ordered probit models are specified so as to test for scope effects and decompose willingness-to-pay into use value and non-use altruistic value effects. The key variables are specified as

$$WTP = \alpha + \gamma lives + \phi lives \times at\ risk \tag{9}$$

where α is the grand constant and measures non-mortality (i.e., morbidity) risk aspects of the PHP policy, γ is the marginal altruistic value of a life saved and $\gamma + \phi$ is the marginal value of a life saved for those at-risk which include both altruistic and use value, where marginal use value is equal to ϕ.

The regression results are presented in Table 4. The sample is split into the two sub-samples, those with non-negative ($\Delta x \geq 0$) and negative ($\Delta x < 0$) PHP consumption effects. For respondents in both subsamples votes vary in the expected direction with the price increase and

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[7] The simulated models are estimated with 1000 Halton draws.

with the number of lives saved, the scope of the policy[8]. In the random effects model, for those who do not decrease oyster consumption with the PHP policy and are at-risk without PHP oysters, votes vary in the expected direction with the scope of the policy[9]. The votes do not vary with the perceived chance of getting sick with PHP oysters. Male and white respondents are less likely to vote for the policy. The likelihood of a vote for the policy decreases with income indicating that the policy is an inferior good. Residents of Louisiana are less likely to vote for the policy. Voting patterns are not affected by raw oyster consumers. Respondents are more willing to pay for the policy if the PHP season is only between April and November. The scale parameter indicates significant correlation across respondent votes.

The results of the random parameters model are similar. Several statistically insignificant coefficients in the random effects model become statistically significant: respondents who think that eating PHP oysters may make them sick, raw oyster consumers and Mississippi residents are all less likely to vote for the policy. The scale parameter indicates significant respondent heterogeneity in the constant term and respondent willingness-to-pay for morbidity risk effects.

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[8] Similar results for the scope test are found when only the first referendum votes are analyzed in an ordered probit and multinomial logit models and when the middle response is dropped and estimated with a binary probit model.

[9] In models with the at-risk variable entered separately and no interaction term the at-risk coefficient is statistically significant for the nonnegative consumption sample and not significantly different from zero for the negative consumption sample.

Those who decrease oyster consumption with the PHP policy and are at-risk without PHP oysters are no more likely to vote for the policy. This indicates that the referendum votes exclusively reveal altruistic values towards lives saved for at-risk respondents. There are no income effects or seasonal effects with the negative consumption sample. Other results are similar to the non-negative consumption sample. A “for” vote is less likely if there is a perceived chance of getting sick with PHP oysters. Male and white respondents are less likely to vote for the policy. Residents of Louisiana and Mississippi are more likely to vote against the policy. Raw oyster consumers are less likely to vote for the policy. The scale parameter indicates significant correlation across respondent votes in the random effects model and significant respondent heterogeneity in the random parameters model.

9. Willingness-to-pay

In order to estimate the benefits of the policy we estimate the aggregate willingness-to-pay to avoid oyster consumption deaths. The typical approach in the mortality risk reduction literature (i.e., value of statistical life, VSL[10]) is to estimate the willingness-to-pay for a risk change, $dr = r - r'$, and scale the willingness-to-pay up to reflect the value of avoiding a sure death by dividing by the risk change:

$$(10) \qquad VSL = \frac{WTP_{dr}}{dr}$$

In contrast, we estimate the individual willingness-to-pay per oyster meal to avoid one life saved and scale up by the number of oyster meals consumed. In general, willingness-to-pay for a change in the k^{th} independent variable is

$$(11) \qquad WTP(\Delta x_k) = \theta(\beta_k \Delta x_k)$$

The standard errors are obtained from the asymptotic covariance matrix by the Delta method (Cameron, 1991). Considering equation (9), the willingness-to-pay per meal to save a life is

$$(12) \qquad WTP|meal = \gamma + \phi$$

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[10] Cameron (2010) discusses problems with the "value of statistical life" terminology and offers an alternative. The USEPA (2010) is also proposing a change in terminology (e.g., willingness to pay for mortality risk reductions).

where $\gamma = \theta\beta_{lives}$ is the altruistic component and $\phi = \theta\beta_{lives\times atrisk}$ is the use value (i.e., own health risk) component. The individual willingness-to-pay is the product of the willingness-to-pay per meal and the number of oyster meals consumed after the PHP policy

(11) $WTP_i = (\gamma + \phi) \times x_i$

Willingness-to-pay estimates are presented in Table 5. Considering the random parameter model estimates for the non-negative consumption sample the altruistic component is equal to \$0.85 per meal, the own health risk component is \$0.27 per meal and total willingness-to-pay is \$1.11 per meal. For the negative consumption sample, the altruistic component is equal to \$1.20 per meal, the own health risk component is less than \$0.01 per meal and total willingness-to-pay is \$1.21 per meal. The weighted average total willingness-to-pay is \$1.13 for the full sample. With the PHP policy and the price increase those who would not decrease oyster consumption with the PHP policy state that they would consume 15 oyster meals annually. Annual willingness-to-pay is \$17 to save one life and \$250 to save 15 lives. With the PHP policy and the price increase those who would decrease oyster consumption with the PHP policy state that they would consume 6 oyster meals annually. Annual willingness-to-pay is \$8 to save one life and \$108 to save the 15 lives. The weighted average annual willingness-to-pay per oyster consumer to save 15 lives is \$216.

Given our willingness-to-pay estimates, one approach to estimate the value per statistical life is to aggregate individual willingness-to-pay over the number of oyster consumers (*n*):

(12) $VSL = \sum_{i=1}^{n} WTP_i$

In the absence of a reliable estimate of the number of oyster consumers we aggregate the marginal willingness-to-pay per meal over the number of oyster meals:

$$(13)\quad VSL = meals\ \times WTP|meal$$

In the introduction we described an estimate for the number of Gulf of Mexico oyster meals consumed annually. The number of annual meals, 9.3 million, is the product of estimates of the annual eastern oyster landings (in pounds), oysters per pound and the inverse of oysters per meal:

$$(14)\quad meals = lbs \times \frac{oysters}{lbs} \times \frac{meals}{oysters}$$

Given the estimate of 9.3 million meals the value of a statistical life from the PHP policy is $10.55 million. However, this estimate requires assumptions for each of the terms in equation (14) for which there is considerable uncertainty. Possible ranges for these assumptions are presented in Table 6. Annual landings have varied from 17 million to 27 million from 2001 to 2009[11]. The number of oysters per pound is approximated by the rule of thumb, 250 oysters in a 100 pound sack. We vary this from 225 to 275. We consider a reasonable range of oysters per meal of 3 to 12. Given these assumptions the number of annual Gulf of Mexico oyster meals ranges from 3.19 million to 24.75 million. However, our stated preference consumption estimates in Table 1 suggest that oyster consumption might fall by 13 percent with the PHP policy. Given this the number of oyster meals would range from 2.77 million to 21.53 million.

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[11] We exclude 2010 when landings were affected by the BP/Deepwater Horizon oil spill.

In addition, our assumption of marginal willingness-to-pay may rely on the theory-supported consequentiality result made by Carson and Groves (2007). If respondents feel that their willingness-to-pay responses in a referendum format may actually influence policy then they will truthfully reveal their willingness-to-pay. A more conservative estimate of willingness-to-pay adjusts downwards for hypothetical bias, which is the empirical observation that hypothetical willingness-to-pay exceeds actual willingness-to-pay. Loomis (2011) describes a number of adjustment procedures of which we implemented one in the first referendum question by asking about respondent certainty about their vote[12].

Using referendum vote responses for the full sample and with undecided votes coded as "against," the Turnbull lower bound nonparametric willingness-to-pay estimates can be found (Haab and McConnell, 2002). The percentage of "for" votes is 44 percent, 35 percent, 33 percent and 26 percent with price changes of $1, $3, $5 and $7. The votes vary significantly with the price increase (χ^2= 35.32[df=3]). The Turnbull willingness-to-pay estimate is $3.16 per meal (s.e.=0.08). In order to adjust for hypothetical bias, we recode those respondents who voted "for" the policy but are somewhat sure, not very sure or not sure at all about their vote to "against" (Blomquist, Blumenschein and Johannesson 2009). With this recode the percentage of "for" votes is 23 percent, 19 percent, 19 percent and 15 percent with price changes of $1, $3 $5 and $7. The recoded votes continue to vary significantly across the price increase (χ^2= 11.52[df=3]). The Turnbull willingness-to-pay is $1.27 per meal (s.e.=0.08). We apply a hypothetical adjustment factor of 40.19 percent to the weighted willingness-to-pay estimates of $1.13 per

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[12] We did not ask certainty follow-up questions in the two follow-up referendum vote questions.

meal for a more conservative willingness-to-pay estimate (Table 6). Given the range of meals and the range of willingness-to-pay per meal estimates, the oyster consumption VSL ranges from $1.26 million to $24.33 million.

Given the large range of assumptions, the range of VSL estimates overstates the likelihood of the extreme values of the estimates. A Monte Carlo simulation is conducted in order to determine a mean VSL and 95% confidence interval. We conduct 1000 simulations over uniform distributions across the range of landings, oysters per pound, oysters per meal and willingness-to-pay per meal. The mean VSL is $5.92 million with a 95% confidence interval of $2.28 million and $13.17 million. This estimate contains both public (i.e., nonuse, altruistic) and private (i.e., use) values.

With our data, private non-altruistic values accrue only to those individuals who would not reduce oyster consumption. We adopt the assumptions above and consider only the 76 percent of meals consumed by the nonnegative consumption sample and the willingness-to-pay of $0.27 per meal. The private good VSL ranges from $0.26 million to $5.08 million. The mean private good VSL from 1000 Monte Carlo simulations is $1.28 million with a 95 percent confidence interval of $0.48 million and $2.81 million.

10. Conclusions

In this paper we used data from an internet-based survey and estimated the benefits of a post-harvest process oyster policy with the contingent valuation method. We examined three issues: a context specific value of statistical life estimate, scope effects in the CVM survey and a decomposition of the VSL into altruistic and mortality risk value estimates.

A number of studies in the mortality risk reduction literature find that willingness-to-pay is insensitive to the scope of the risk change. In this study, instead of asking respondents to value difficult to understand changes in small probabilities, we ask respondents about their willingness-to-pay for lives saved directly. We find that respondents are more likely to vote for the policy as the number of lives saved increases. Some respondents, those who have a health condition so that they are at-risk from *Vibrio* contamination and state that they would not decrease oyster consumption if they are post-harvest processed, are even more likely to vote for the policy as lives saved increases. This result suggests that in previous applications of the contingent valuation method, a lack of sensitivity to scope may be a function of respondent difficulty with small probability changes instead of a lack of validity. Valuation questions that present changes in deaths may be more easily understood by respondents. While willingness-to-pay may be more difficult to aggregate to generate value of statistical life estimates, they may be more valid.

All else constant, the total value of a public program is the sum of use value and nonuse value. Aggregating over users and nonusers should lead to greater aggregate benefits compared to aggregation over just users. Previous research has found that willingness-to-pay for public safety programs is lower than for private safety programs. This result follows the theoretical literature regarding altruism and benefit-cost analysis, where it is argued that altruistic values should not be included unless they are paternalistic. Nonpaternalistic altruistic respondents may vote against a policy that imposes costs on others. We identify those respondents who would actually benefit from the policy and distinguish between the private and public goods. Since our payment vehicle is a price increase for those who might benefit from the policy, the benefits and costs accrue to the same individuals. As a result the total benefits of the PHP policy can be decomposed into benefits accruing to users and nonusers and an estimate of the private value of statistical life can be developed. Nonpaternalistsic altruistic values represent over three-fourths of total value.

No study has estimated the willingness-to-pay for specific reductions in health risk from oyster consumption even though *Vibrio* ranks as the fourth leading cause of foodborne pathogen death. Oyster safety policy analysis must rely on willingness-to-pay estimates from the labor market or other VSL literatures. A number of studies have found that willingness-to-pay can vary across the source of health risk which raises the question of whether existing oyster safety policy analyses have accurately compared benefits and costs. In the policy application we took steps to mitigate hypothetical bias by survey design, Turnbull estimation, and calibration by follow up certainty. We find that willingness-to-pay per life saved is $1.28 million for the pure private good of own-mortality risk reduction. Willingness-to-per per life saved including private values and public, altruistic nonuse values is $5.92 million. Previous studies that have compared benefits and costs of oyster safety policy using benefit transfer estimates from the labor market, road safety or food safety literatures may have used biased estimates (Keithly and Diop, 2001).

These results could be used to conduct benefit-cost analysis and inform food safety policy. An example of this type of benefit-cost analysis in the food safety literature is Buzby, Ready and Skees (1995) who use CVM to estimate the willingness-to-pay to avoid pesticide risks to grapefruit. Using estimates of willingness-to-pay for safer grapefruit, the aggregate amount of grapefruit consumed and other assumptions, they estimate the value of a statistical life to be $6.19 million ($2010). Using this estimate, information for price and cost changes, they find that the benefits of a pesticide ban outweigh costs.

Muth et al. (2010) estimate the costs of the PHP policy. They find that the annual cost of PHP oysters in the summer months is $9 million per year. This includes upfront capital costs of between $8 million and $35 million. Considering that the PHP could lead to a reduction of 15 premature deaths annually and considering the private value of each life saved equal to $1.28 million, it appears that the PHP policy is efficient. However, a full benefit-cost analysis should include additional costs such as lost consumer surplus from the reductions in oyster consumption and additional benefits such as the value of reduced morbidity risk and altruistic values.

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Table 1. Revealed and Stated Preference Oyster Meals

Change in consumption with PHP is zero or positive ($\Delta x \geq 0$)						
	Total		Cooked		Raw	
Label	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
RP oyster meals	18.01	33.32	14.56	27.75	3.45	11.89
SP oyster meals	16.54	27.87	9.45	18.68	7.09	21.08
SP PHP oyster meals	17.24	29.01	10.41	20.73	6.82	21.44
n = 1407						
Change in consumption with PHP is negative ($\Delta x < 0$)						
	Total		Cooked		Raw	
Label	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
RP oyster meals	20.56	33.32	16.67	29.56	3.89	13.99
SP oyster meals	19.59	31.04	10.46	17.54	9.13	22.00
SP PHP oyster meals	7.88	18.10	5.74	13.59	2.14	10.69
n = 442						

Table 2. Referendum Votes

Change in consumption with PHP is zero or positive ($\Delta x \geq 0$)

Cost	For	Undecided	Against	%For
1	150	93	108	43%
3	119	111	127	33%
5	106	108	136	30%
7	92	100	157	26%
Total	467	412	528	33%
χ^2(df)	27.08(6)	p=.01		

Change in consumption with PHP is negative ($\Delta x < 0$)

Cost	For	Undecided	Against	%For
1	57	26	32	50%
3	40	30	31	40%
5	45	28	39	40%
7	29	36	49	25%
Total	171	120	151	39%
χ^2 (df)	15.22(6)	p=.05		

Table 3. Data Summary

		$\Delta x \geq 0$		$\Delta x < 0$	
Variable	Description	Mean	StdDev	Mean	StdDev
price change	increase in price	3.99	2.23	4.02	2.27
lives	lives saved with PHP policy	9.99	4.08	9.97	4.17
sick	1 if chance of getting sick with PHP oysters (0 = not likely)	0.47	0.50	0.76	0.43
age	2010 - year born	45.21	16.02	41.85	16.99
male	1 if male, 0 if female	0.52	0.50	0.39	0.49
education	years schooling	14.98	2.31	14.62	2.17
household size	household size	2.56	1.30	2.77	1.48
children	number of children in household	0.53	0.95	0.60	1.05
white	1 if race is white, 0 otherwise	0.80	0.40	0.68	0.47
income	household income ($1000s)	63.71	44.07	58.32	43.32
at-risk	1 if has illness increasing risk from eating raw, 0 otherwise	0.17	0.38	0.20	0.4
raw	1 if eats raw oysters, 0 otherwise	0.39	0.49	0.38	0.49
CA	1 if California resident, 0 otherwise	0.18	0.38	0.21	0.41
FL	1 if Florida resident, 0 otherwise	0.18	0.38	0.20	0.4
GA	1 if Georgia resident, 0 otherwise	0.13	0.33	0.14	0.35
LA	1 if Louisiana resident, 0 otherwise	0.21	0.41	0.13	0.34
MS	1 if Mississippi resident	0.13	0.33	0.13	0.34
TX	1 if Texas resident, 0 otherwise	0.19	0.39	0.18	0.38
Sample size		1407		442	

Table 4. Ordered Probit Models: Dependent variable = Three Referendum Votes

	$\Delta x \geq 0$				$\Delta x < 0$			
	Random Effects		Random Parameters		Random Effects		Random Parameters	
Variable	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Constant	1.317	6.052	1.323	11.681	1.098	3.673	1.100	5.889
price change	-0.108	-4.239	-0.109	-9.686	-0.062	-1.654	-0.062	-3.172
lives	0.093	9.971	0.092	15.149	0.075	4.761	0.075	7.100
lives × at-risk	0.029	3.202	0.029	6.612	0.000	0.012	0.000	0.017
income	-0.003	-2.001	-0.003	-4.587	-0.001	-0.313	-0.001	-0.594
sick	-0.144	-1.259	-0.150	-3.026	-0.627	-3.170	-0.626	-6.072
white	-0.610	-4.001	-0.604	-9.243	-0.359	-1.943	-0.359	-3.615
male	-0.530	-4.454	-0.526	-10.331	-0.367	-2.185	-0.367	-4.032
raw	-0.102	-0.877	-0.101	-1.990	-0.317	-1.835	-0.318	-3.414
La	-0.539	-3.706	-0.550	-8.892	-0.566	-2.127	-0.568	-4.353
Ms	-0.182	-1.082	-0.188	-2.478	-0.319	-1.352	-0.317	-2.417
Season	0.172	2.000	0.171	2.434	-0.123	-0.846	-0.123	-0.965
μ_1	1.515	26.144	1.514	40.887	1.217	16.312	1.217	22.689
σ	1.758	15.736	1.757	37.491	1.284	8.275	1.286	19.422
Sample size	2946		2946		869		869	
Individuals	1407		1407		442		442	
Periods	3		3		3		3	
LL Function	-2949.03		-2949.01		-887.83		-887.84	

Table 5. Marginal Willingness-to-pay Per Meal to Avoid One Death

	$\Delta x \geq 0$	$\Delta x < 0$

	Random Effects		Random Parameters		Random Effects		Random Parameters	
	WTP	t-stat	WTP	t-stat	WTP	t-stat	WTP	t-stat
Altruistic (public good)	0.86	4.13	0.85	8.61	1.21	1.65	1.20	3.01
Own health risk (private good)	0.27	2.65	0.27	5.62	0.00	0.01	0.00	0.02
Total (public and private goods)	1.12	4.13	1.11	8.89	1.21	1.64	1.21	2.92

Table 6. Value of Statistical Life Assumptions and Calculations

Calculation	Variable	Low	High	Scenario
(1)	Landings (million pounds)	17	27	Baseline
(2)	Oysters per pound	2.25	2.75	
(3) = (1) × (2)	Oysters (millions)	38.25	74.25	
(4)	Oysters per meal	12	3	
(5) = (3) ÷ (4)	Meals (millions)	3.19	24.75	
(6a) = .87 × (5)	Meals with demand adjustment (millions)	2.77	21.53	Private and Public Values
(7a)	Willingness-to-pay per meal	0.45	1.13	
(8a) = (6a) × (7a)	VSL (millions)	1.26	24.33	
(6b) = .76 × (5)	Meals with demand adjustment (millions)	2.42	18.81	Private Values
(7b)	Willingness-to-pay per meal	0.11	0.27	
(8b) = (6b) × (7b)	VSL (millions)	0.26	5.08	