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The Economic Assessment of Claims for Oil Pollution Damages : The Canadian Experience*

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Abstract

Ⅰ. Introduction

The transportation of oil and non-oil cargo at sea has been a vital link in the world economy for several decades. Unfortunately, moving this much oil and non-oil cargo by tanker and bulk carrier results in major marine oil spill incidents such as Exxon Valdez in Alaska in 1989 and Erica off the west coast of France in 1999. In such cases the inability of responders to prevent spilled oil from fouling beaches and damaging wildlife and coastal resources is all too plainly demonstrated to an increasingly environment-conscious public by a media that now has the capability to relay dramatic real-time pictures around the world. However, the concerted efforts of the International Maritime Organization, individual governments, the oil transportation industry and various other key groups have resulted in a dramatic reduction in the incidence of major tanker spills over the past two decades, as suggested by Figure 1.

Whilst the relatively small number of spills over 700 tonnes precludes detailed statistical analysis and there are considerable annual variations, the overall trend is clear. Thus, the average number of spills of this size each year in the 1980s and 1990s was about one-third of that experienced in the 1970s (White, 2000). Even though major oil spills are now exceptionally rare events since 1980, developing environmental policies to prevent and manage oil spills still presents coastal

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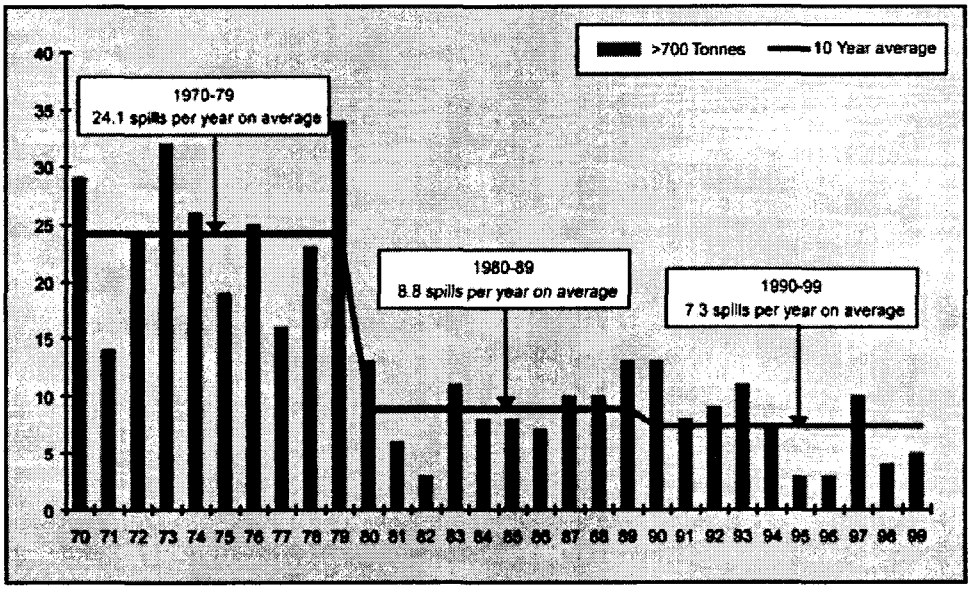
countries such as Canada and Korea with important and difficult challenges. Several policy options are available for preventing marine oil spills: double-hulled tankers, vessel transit systems, and expanded vessel manning or escort requirements. Oil spill prevention also can be sought through the use of incentives. One set of incentives for preventing and managing oil spill is provided by liability for losses due to spills. An effective liability system internalizes the costs of spills using the polluter pays principle and can provide a sustainable basis for restoring coastal resources injured by spills (Grigalunas et al., 1998).

When economists began investigating pollution control policy in the 1960s, they advocated the polluter pays principle as the preferred approach for promoting environmental protection. The essence of this approach is that polluters are confronted with the full social costs of their actions. Instead of being regulated in minute detail, they are left free to manage their production and waste generation knowing that they will be made to pay the full cost of any environmental damage that they cause.



(source : White, I.C., *Oil Spill Response : Experience, Trends and Challenges,* August, 2000, Darwin, Australia, p. 2.)

〈Figure 1〉 Tanker Spills over 700 tonnes, 1970-1999

However, this advice was largely rejected when pollution control programs were instituted in the 1970s. Lawmakers and regulators turned instead to command-

and-control systems. As time passed, this choice has been found wanting. In recent years, there has been a growing awareness that environmental protection is an expensive activity, even though it is very necessary. Because of this, it is extremely important that the environment be protected in a cost-effective manner. Cost effectiveness is far more likely to be attained through approaches based on the polluter pays principle than through command-and-control regulation.

Hence, the recent surge of interest in incentive schemes and market-like systems in the United States, the European Community, the United Nations Environmental Program, and many other national and international organizations involved with environmental protection. Natural resource damage assessment (NRDA) is an obvious complement to these mechanisms. It extends the polluter pays principle to potential responsible parties by giving them a clear financial incentive to be vigilant in preventing hazardous releases and confronting them with the full social costs of the consequences if they fail to do so (Ward and Duffield, 1992).

Even though NRDA can be an important incentive policy instrument for protecting the marine environment, one critical issue it faces is to quantify environmental damages resulting from oil spill incidents in monetary terms. The conceptual monetary measure of the change in an individual's well-being from a change in environmental quality can be thought of as the change in income that yields the same or offsetting change in the individual's well-being as does the change in environmental quality. In general, the value held by individuals for natural resource damage caused by oil spills can be classified into two categories: use value and passive use value (or non-use value). The use value refers to the value of activities affected by natural resource damages, including commercial or recreation fisheries and public beach use. On the other hand, the passive use value refers to value individuals hold to protect or enhance resources not related to their own use. This may include bequest value related to potential use value impacts to others now and in the future, and to protect the existence of resources such as clean beaches, seabirds, marine mammals, etc. Since passive use value involves no market transactions that might be used as data, it is particularly difficult to assess and non-market method such as contingent valuation method (CVM) using surveys must be employed. Despite many advances in the literature, estimates of passive use value by using theoretical model such as CVM remain a contentious issue in natural resources damage assessments (Grigalunas et al., 1998). Nevertheless, CVM has become a topic of intense interest in the area of

NRDA because it was and still is the only methodology capable of measuring passive use value.

Furthermore, in the case of oil spills, the scope of payment for environmental damages is different between international conventions and national laws. For example, there is a longstanding International Oil Pollution Compensation Fund (IOPC Fund) policy that natural resource damages estimated by a theoretical model such as CVM are not eligible, while U.S. courts accept the appropriateness of CVM which is regarded as the only methodology presently available to measure passive use values, under the Oil Pollution Act of 1990. Although Canada is a member of international conventions for addressing claims resulting from marine oil spills, it has expanded potential oil spill liability to cover broader categories of losses than has been allowed under international conventions such as the 1992 International Convention on Civil Liability for Oil Pollution Damages (1992 CLC) and the 1992 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damages (1992 Fund Convention), provided that such losses can be reliably estimated.

This paper is to examine the basic issues that must be resolved in any successful application of a theoretical model such as CVM to estimating natural resource damages from oil spills and to investigate the Canadian experience in funding environmental damage restoration projects by using compensation money for the environmental damages. In order to do that, this paper reviews an example of applying CVM to estimate passive use damages from the 1988 Nestucca oil spill, performed by RCG/Hagler, Baily, Inc. This paper covers the estimation of economic damages only to citizens of British Columbia, Canada related to natural resource damages resulting from the Nestucca oil spill. The Nestucca case provides a significant opportunity to understand the mechanics and validity of CVM for quantifying oil spill damages in monetary terms. For Canada, the Nestucca case is particularly important because this case established it is possible to do natural resource damage assessment and restoration in oil spills. Hence, the paper also discusses the Canadian experience in environmental damage restoration, especially in funding restoration projects with the compensation money that the polluter paid for the environmental damages.

The remainder of the paper is organized as follows. Comprehending the passive use value and CVM debate requires an understanding of the economic theory of natural resource damage assessment. This paper provides a brief discussion of the economic theory of NRDA including CVM. Next, the paper presents a CVM case

study of environmental damages due to the 1988 Nestucca oil spill illustrating how CVM is used to measure the economic value of passive use damages from an actual oil spill incident. Then, the paper discusses the Canadian experience in funding environmental restoration projects. Finally, the paper presents the summary and some conclusions about the role that CVM estimates of environmental damage might play in NRDA, and discusses a Canadian perspective on natural resource damage assessment and restoration.

II. The Economic Theory of Natural Resource Damage Assessment

1. The Concept of Economic Value

To economist, the term value has a very specific meaning. The most important but often overlooked feature of economic value is that it is a theoretical construct and that monetary measures of economic value are inferred by analysts from the choices that individuals make. Economic value cannot be independent of a choice.

A choice implies that an individual is confronted with a selection of alternatives and the consideration of the alternatives by the individual defines a trade-off. Contemporary economic theory of individual behaviour when confronted by choices suggests that what is chosen must be at least as desirable, from the perspective of the individual making the choice, as the alternatives that were not chosen. The theory implies that the alternative chosen is at least as good, or as valuable, as the alternatives that were not chosen and thereby defines value for the alternative chosen in terms of the alternatives foregone. For example, if an individual chooses to relinquish three apples for a peach, an observing analyst can state that under the circumstances of the choice, the economic value to that individual of the peach is at least three apples. If the choice were giving up $1 for the peach, and the individual chose the peach, then the analyst would conclude under the circumstances of the choice that the value of the peach to that person was at least $1.

Objects of choice may be quite general and extend far beyond our normal conception of private goods sold in markets. Objects of choice can be public goods like clean air, water quality, beach, seabird, species and habitat protection. But the list does not stop here. Objects of choice can be any tangible or intangible object, process and activity that can be described in a way that allows a choice to be fashioned (Kopp and Pease, 1997).

2. The Valuation Methodologies of NRDA

The foundation for valuation in natural resource damage assessment is welfare economics. Welfare economics provides the tools and concepts for measuring changes in individual and aggregate well-being as a basis for judging the effects of economic changes. Measures of welfare change provide a conceptual basis for the application at hand: measuring the damages associated with injury to natural resources like shorelines, seabirds, marine mammals and eagles. Put most simply, natural resource injury and the associated reduction in natural resource services make users of these services worse off.

The major division in the valuation methods of NRDA is between cost estimating methodologies and lost use and passive use valuation methodologies. Furthermore, the lost use and passive use valuation methodologies can be classified based on how closely they are related to actual working markets. Four classes are then possible: (a) market-based, (b) related market or revealed preference, (c) hypothetical markets, and (d) benefit transfer (Ward and Duffield, 1992). Hence, a classification of methods for measuring natural resource damages is as follows:

A. *Cost estimating methodologies*
- Restoration cost method

B. *Lost use and passive use valuation methodologies*
- Market-based method
- Related market or revealed preference method (factor income, travel cost, hedonic pricing)
- Hypothetical market method (contingent valuation)
- Benefit transfer method (unit day value)

(1) Cost estimating methodologies

From the standpoint of microeconomic theory, the cost estimating methodologies and lost use and passive use valuation methodologies correspond to the supply and demand sides, respectively, of a given resource service. Typically, the public resources and related services at issue in a natural resource damage setting are not produced in the usual sense because they derive from natural processes. This is the case for wildlife, fisheries, the flow of clean water in a river, or the biota in a healthy wetland. However, when these resources are injured in a natural resource damage setting, one alternative basis for damages is the cost to restore,

rehabilitate, replace, and/or acquire equivalent resources. The estimation of restoration costs, broadly defined, is analogous to the problem of production faced by a firm. The result of the restoration cost analysis should generate something akin to a supply curve defining the minimum costs associated with providing varying levels of the resource service.

(2) Lost use and passive use valuation methodologies

The lost use and passive use valuation methodologies are primarily focused on the demand side, and on identifying willingness to pay for a given resource service. These methods can be classified into four classes based on how closely they are related to actual working markets: market-based, related or revealed preference, hypothetical markets, and benefit transfer.

For *market-based methods* to be applicable, actual markets must exist for the resource service in question. When this condition holds, such as in a commercial fishery, damages can be measured by the diminution in market price associated with the injury. Where markets exist for the same or similar resources, appraisal methods can be used to identify with- and without- injury appraisal values. The difference is the measure of damages.

Even though market does not exist for specific natural resources, there are types of resource services for which values and preferences are revealed by related markets. The following three methods fall within this class: factor income, travel cost, and hedonic pricing.

The factor income method is viable when the resource service is an input to market products. The related market for this method is the market for the final product. One can identify the relationship between changes in the level of the factor of production (or input) and the effect on net income. For example, fish is an input for commercial fisheries, and water is an input for irrigated agriculture. Injuries caused by oil spills can change fish stocks or change the quantity or quality of irrigation water. These in turn affect the economic returns for firms in these industries. This method requires a model of production technology relating inputs to outputs.

The travel cost method is a special approach for valuing recreational use of sites, generally outdoor recreation sites, where travel is essential for access to the resource. The related market in this case is the market for travel services to the site. Travel involves marketed services and commodities with real costs, such as airfare and gasoline. The travel costs to a given site are, in a way, the price of

access to the site. Because these prices vary spatially (individuals travelling longer distances incur greater travel costs), it is possible to infer a demand relationship for the site. By identifying the effect of injury on the demand for the site, damages can be estimated based on the difference of the with- and without-injury cases.

Hedonic pricing is a third method for utilizing information from related markets to estimate damages. This method applies in cases where natural resources are an important attribute of a marketed resource. For example, houses and land are complex commodities with many important possible attributes, including size, location, scenic qualities, proximity to clean water, and clean air. This method uses estimates of the relationship of observed market pricesfor example, for shoreline propertyto varying levels of the key attributes. The effect of an injury-caused change in the key attribute, such as water quality, can then be measured in a price change for the marketed property. The latter provides a measure of damages.

Where actual markets or related markets do not exist for a given resource service, a third general approach is to use *hypothetical markets*. In this method, called *contingent valuation*, individuals are surveyed who have a stake in a given resourcefor example, birdwatchers who visit an injured wetland. A hypothetical market situation is described to the survey participants. Recreationists might be asked to suppose that there was an access fee for the use of the wetland for watching birds. Valuation responses are obtained from participants contingent on their acceptance and understanding of the hypothetical situation (hence the term contingent valuation). This very flexible technique is essentially limited only by the interviewer's ability to make the hypothetical setting understandable for the respondent. As noted earlier, this is the only viable method for estimating passive use values. Among numerous variations, four different methods to obtain the respondents' willingness to pay for the environment goods can be distinguished: bidding games, open-ended questions, payment card formats, dichotomous-choice questions. However, researchers continue to disagree about which of these techniques is best. Each researcher has a favorite, and variations on the four best techniques discussed here are constantly being developed.

The debate over CVM is a debate that can only be resolved with empirical evidence. Too often, the critics of CVM simply speculate about what might go wrong in CVM studies and then assume that those things actually do go wrong. On the other hand, CVM practitioners have probably been far too willing to accept the results of their studies at face value. In order to consider the empirical

evidence systematically and objectively, the ground rules must be determined in advance. What is needed is a theory of measurement for CVM that can guide the empirical research (Bishop, et al., 1997).

The fourth category of valuation methodologies is a catch-all: *benefits transfer.* The term is used to indicate any case where the value of a given resource service is based on previously estimated values for similar resources or experiences. Previous estimated for similar resources could have been derived using any of the other methods that we already mentioned. One specific benefit transfer method is the *unit day value method.* The application of this method requires the assumption that the resource, user, and experience are in fact comparable. Generally, this approach would only be used for minor spills or where it is not possible to do a site-specific study.

Until recently, economic valuation studies related to natural resource damage claims concentrated exclusively on the measurement of lost use and non-use values. Economist working in this area always knew that lost values were affected by the speed and level of ecosystem recovery, and that these were influenced, to a large extent, by restoration efforts. Indeed, the most interesting questions in all of economics involve the valuation of natural capital and the role that the revealed or expressed preferences of the current generation should play in decisions to conserve, protect, and restore natural capital. The recent adoption of a restoration based approach for assessing damages will side-step the need to value explicitly lost services when resources are injured in many future oil spill cases. To the extent that this occurs, monetary valuation issues are reduced in significance. However, quantification of injury and lost services still is required and can be difficult. In addition, monetary valuation will be used in some cases and is required to assess whether restoration costs are grossly disproportionate to benefits (Grigalunas et al., 1998).

Ⅲ. The Application Example of a Theoretical Model in Canada

1. Overview of the Nestucca Oil Spill

On 23 December 1988, a collision occurred between the fuel barge *Nestucca* and its tender tug *Ocean Service* off the mouth of Grays Harbour in the state of Washington, U.S. The barge had a cargo capacity of 11.2 million litres and was transporting heavy Bunker C oil. An estimated 875,000 litres of this volume was

reported to be spilled near Grays Harbour, which is located 175 km from the Canada-US border. The oil was first reported on the British Columbia coast, Canada, arriving as small patches at Cape Scott on about January 14. Oiling was reported as far south as Victoria, and traces of Nestucca oil landed on islands off the northern mainland near Bella Bella. The 875,000 litres of Bunker C oil travelled along the Pacific Coast from Oregon to Pacific Rim National Park and on to northern Vancouver Island about 350 km in Canada (Duval et al., 1989).

The environmental damages consisted of thousands of oiled seabirds, uncounted predatory birds, some seals and sea lions, and two sea otters. According to more detailed studies of seabird colonies and predatory birds, 3568 dead oiled seabirds were found in Canada, and 10,336 were found in Washington, of 31 species, with a calculated total mortality of 51,400. Besides this, the traditional seafood of First Nation (Nuu-Chah-Nulth) on the west coast of Vancouver Island were harmed, and several fisheries such as crabs, rockfish, and herring were affected. The beaches in the Pacific Rim National Park, which is known worldwide for its scenic splendour, abundant natural resources, unique life forms and geology, were also badly oiled (Pond, 1997).

U.S. and Canada Governments and the Nuu-Chah-Nulth First Nation filed suit in U.S. Federal Court to recover the costs of cleanup and related expenses, and for damages to the environment. The barge owners, *Sause Brothers Ocean Towing*, sought to limit their liability. The case was heard in U.S. District Court in the company's home state of Oregon. Environment Canada and the British Columbia Ministry of Environment hired RCG/Hagler, Baily, Inc., the Colorado consulting firm, to estimate the economic value of the natural resource damages due to the Nestucca oil spill.

2. The Estimation of Environmental Damages by CVM

This paper reviews a well-known CVM study[1] of damages resulting from the 1988 Nestucca oil spill, performed by RCG/Hagler, Baily, Inc. and published in 1991. This case is particularly interesting because it was a large-scale CVM study of an incident that involved mainly passive use value. In addition, the CVM

1) NOAA's Blue Ribbon Panel of prominent economists concludes that CVM studies can produce estimates reliable enough to be the starting points of a judicial process of damage assessment including lost passive use values. To be acceptable for this purpose, the panel recommends certain guidelines. Following the guidelines will make a CVM study a very expensive item, estimated at $5-7million per CVM study.

case study was the basis for an actual claim for damages in the court, not an experiment, and the researchers faced many of the difficulties that commonly arise in attempts to apply CVM in oil spill NRDAs. They made many creative attempts to anticipate and correct for various biases (Grigalunas and Opaluch, 1993). By reviewing the CVM study of the Nestucca case, we can have a good opportunity to understand the mechanics and validity of CVM for quantifying passive use damages in monetary terms.

(1) Survey Design and Implementation

To estimate the economic value to citizens of British Columbia and Washington of natural resource injuries caused by the Nestucca oil spill, four survey versions were implemented.

Survey Version 1 provides the baseline instrument providing information upon, and valuing, all types of oil spills. Version 2 addresses only a single moderate spill to examine the *embedding* issue and other economic issues in greater detail. Both Version 1 and 2 were implemented in British Columbia and Washington with only minor word changes to reflect local vernacular. Version 3 and Version 4 provide information to address specific CVM design issues. Version 3 was implemented only in Washington and Version 4 was implemented only in British Columbia. Versions 3 and 4 were not implemented in both British Columbia and Washington as the effect of the design variations examined is expected to be similar in both locations. Except for identified design changes, all survey versions use the same questions.

British Columbia and Washington samples were selected from telephone listings so that each household had an equal probability of being sampled. From now on, we focus on the study for the sample of British Columbia, Canada because this paper deals with the Canadian experience on the environmental damage assessment and restoration. In British Columbia, the survey was mailed to 1,800 households700 copies each of Version 1 and 2 and 400 copies of Version 4. The survey was implemented from October 1990 through February 1991, using a Dillmann (1978) repeat mail procedure with a telephone follow-up. The net overall response rate, 72.7 percent, adjusted for incorrect addresses, yields 1,224 respondents.

(2) Estimates of WTP to Prevent Oil Spills

WTP Question: A Payment Card Approach

The survey is designed to neutrally present the issue of future levels of oil spill

protection as a regulatory question of interest to government and industry officials. For example, the first cover letter includes the following :

"Government and industry officials throughout the Pacific Northwest are evaluating programs to prevent oil spills in this area. Before making decisions that may cost you money, these officials want your input."

Throughout the survey, the design reinforces the interest in the issue from a future regulatory perspective. In CVM practice, ex ante (before the fact) valuations are generally preferred to ex post (after the fact) valuations. The ex ante regulatory perspective also eliminates any indication the results relate to damages in pending litigation. Finally, the ex ante regulatory perspective is consistent with potential future uses of the results beyond the Nestucca case.

The survey instruments elicit values for the prevention of all spills and for preventing spills with different magnitudes of natural resource injury. Four general categories of spills are defined, which can be summarized as :

A. *Spill with Large Impacts*: A once in a lifetime chance of a spill with large impacts that kills up to 300,000 seabirds, kills other wildlife, and has significant fishery and shoreline impacts.
B. *Spill with Moderate Impacts*: One spill each 5 years with moderate impacts that kills about 40,000 seabirds and has some shoreline impacts.
C. *Spill with Small Impacts*: Several spills each 5 years with small impacts that kill about 1,000 seabirds.
D. *Spill with Very Small Impacts*: Other very small oil releases that routinely occur in the coastal waters of the Pacific Northwest, but have few wildlife and shoreline effects.

Survey Version 1 and 3 value the prevention of all spills for five years in the Pacific Northwest. These total values are then partitioned into values for the prevention of spills for each of the four groups listed above. Five-year period was selected to match the identified frequency of a moderate spill (like the Nestucca spill) somewhere in the Pacific Northwest. Versions 2 and 4 directly value the moderate spill, which is defined to be a conservative representation of the Nestucca spill where the magnitude of the actual seabird kill is estimated to have exceeded 50,000, and where other effects may have occurred that were not considered in the scenario.

The WTP elicitation in the survey employs a payment card approach where respondents have the option to review a variety of potential alternative payments (for example: $0, $5, , $5,000, more than $5,000) and choose the best response. This approach was selected as opposed to an open-ended questions, because the researchers have found that payment cards tend to have lower item non-response rates in mail surveys than do open-ended WTP questions. The payment card was also selected over the referendum approach to obtain greater estimation efficiency for the selected sample size (Cameron and Huppert, 1988) and because of other statistical uncertainties in the interpretation of referendum approach data (McConnell, 1990).

Values for Prevention of Oil Spills

Several statistical interpretations of the data are undertaken by the economists of RCG/Hagler, Bailly, Inc., leading to a range of results provided in Table 1. The statistical results are based on the data cleaned by consistency checks procedure.

In comparison to *low/high* estimates, the *central* estimates provide a traditional, yet conservative, consistency check interpretation of the WTP results that eliminates protest zero WTP responses and many large WTP responses. These central estimates also rely upon the most conservative valuation among the alternative survey versions. The low estimates rely upon a developing approach that is even more conservative and assumes a log-normal measurement error is present in the reported WTP responses. This has the effect of assuming many moderate and large WTP responses are due to measurement error by the respondent rather than due to underlying true values. These low estimates are also based upon the most conservative valuation among the alternative survey versions. The high estimates for the moderate spill are based upon traditional CVM statistical analysis of the results of Version 2 and 4, which directly value a Nestucca type spill.

In the case of British Columbia sample shown in Table 1, one can note that about 46 percent of total value ($135/$295) for preventing all oil spills in a five year period is assigned to reducing the probability of a spill with large impacts, 28 percent ($80/$295) is for the prevention of a spill with moderate impacts, 16 percent ($50/$295) is to prevent several spills with small impacts and 10 percents ($30/$295) is to prevent routine very small oil releases. The low estimates are about 33 to 55 percent less than the central estimates for British Columbia households. The high estimates are nearly double the central estimates, which are

consistent with traditional CVM valuation approaches (RCG/Hagler, Bailly, Inc., 1991).

〈Table 1〉 Estimates to Prevent Oil Spills in the Pacific Northwest

Size of Spill	British Columbia Low/Central/High	Washington Low/Central/High
All spills	$160 / $295 / NC	$240 / $335 / NC
Large spill	$70 / $135 / NC	$110 / $160 / NC
Moderate spill	**$45 / $80 / $175**	**$65 / $95 / $175**
Small spills	$30 / $50 / NC	$40 / $50 / NC
Very small spills	$20 / $30 / NC	$25 / $25 / NC

1. Values rounded to nearest $5.
2. Dollars reported in currency of sample group.
3. Bolded moderate spill case represents values for the Nestucca oil spill.
4. High estimates computed only for the moderate spill case.
5. NC means Not Computed .

(Source: RCG/Hagler, Baily, Inc., *Contingent Valuation of Natural Resource Damage Due to the Nestucca Oil Spill: Final Report*, Boulder, Colorado, 1991, pp. 6-8)

Using these results, damages per British Columbia household from the Nestucca spill, which belongs to moderate spill, were estimated to range from $45 to $175 with a central estimate of $80 (in 1990 Canadian dollars). These estimates were viewed by the researchers as conservative. The implied total damages to British Columbia can be estimated by applying RCG's damage per household to all British Columbia households. This results in a central estimate of damages of about $80 million. The central estimate of damages per household for Washington State is $95 (in 1990 U.S. dollars). Applying these figures to Washington State's approximately 1.7 million households implies a central estimate of damages to Washington State of about $160 million (Grigalunas and Opaluch, 1993).

(3) CVM Method Issues

Part-Whole Embedding

Survey Version 1 and 2 were specifically designed to examine the effect of varying two presentations :

- Version 1 presented information on all four spill categories, valued the prevention of all spills, and apportioned the total value among spills with different levels of resource injuries.

- Version 2 presented only information on a moderate spill and directly valued the prevention of such spill. The existence of other spills is recognized but is not discussed at length.

The survey results indicate that the moderate spill values in the single spill valuation approach (Version 2) are about double those computed in the all spill approach (Version 1). There are a number of possible explanations for this result. The first is that the value for the prevention of other oil spills is embedded in the reported value for preventing the moderate spill in the single spill valuation approach. Some survey evidence suggests that this is at least partly the case and that respondents, in part, recognize and can correct for this. Alternatively, it may be the case that the prevention of different oil spills is treated as substitute goods with diminishing marginal utility. Under this economic rational, the value of preventing a moderate spill is larger if it is the only spill prevented.

Temporal Embedding

The second CVM issue concerns the elicitation of value through a total payment over five years, as used in survey Versions 1, 2 and 4, or as an annual payment for five years, as in survey Version 3. This provides an examination of one issue raised by Kahneman and Knetsch (1992) concerning the possibilities for temporal embedding, or the lack of respondent awareness to the payment period. Kahneman and Knetsch argue that respondents may not actually consider the period of payment and may provide the same WTP regardless of whether it is an annual or a total payment.

The survey results suggest that the use of annual payments would result in comparable, or slightly higher, values than when using the five-year total payment. This may occur if the total payment is perceived to occur up front. In this case, given normal discount rates and uncertainty about living in the area in the future, the five-year total payment should be less than five times the annual payments. In fact, there is a high degree of consistency between the annual and five-year total payments.

Zero WTP Responses

In all CVM studies, an effort is made to evaluate $0 WTP responses to determine whether the respondent really means he or she does not value the hypothetical change being considered, or whether the response reflects some objection to the question and should not be interpreted as a true zero value for the

resource change in question. McClelland et al. (1991) suggest that zero responses may also reflect the fact that respondents do not know the value, or do not want to expend the effort required in the exercise and, therefore, opt not to engage in the question.

A typical case of a $0 WTP response that represents a likely protest or rejection of the CVM scenario is a respondent who also states that he or she is quite concerned about the environment, or about injury to seabirds and other wildlife from oil spills, and who states that more effort should be spent to prevent future oil spills. These response patterns are often accompanied by written protest comments and by responses to other questions that suggest that responsibility for payment lies elsewhere than with the household. The most frequent comment is that the oil industry should pay for oil spill prevention. This sentiment can be expected to be associated with zero and reduced WTP value statements. Hence, $0 WTP response is deleted if written comments are judged to be protest or rejection of the CVM scenario.

Large WTP Response

Large WTP responses are a concern in CVM analysis as potential measurement error in these responses can have significant impact upon the computed mean WTP value estimates. To be conservative in the interpretation of the results, all WTP responses in excess of one percent of annual pre-tax household income are deleted. Although some absolutely large WTP responses remain due to high household income and other factors, this data trimming results in a conservative treatment of the large WTP responses as a whole. For example, respondents with high WTP responses on the whole also report a very high level of importance to preventing future oil spills.

(4) Limitation of the Nestucca CVM Study by RCG/Hagler, Bailly, Inc.

This paper reviews the CVM study of the Nestucca case in detail. The survey carried out by RCG/Hagler, Bailly, Inc. was carefully designed and included many innovative attempts to correct various biases of CVM by using four different versions and consistency check approach. Nevertheless, this paper also examines some limitations of the CVM study while reviewing it. One is related to the focus of the CVM study scenario, which is the program to prevent oil spills, but not specific environmental damages due to the Nestucca oil spill. The other one is concerned with whether respondents have well quantified natural resource damages

resulting from the Nestucca oil spill in monetary terms.

To estimate the economic value to citizens of British Columbia and Washington of natural resource injuries caused by the Nestucca oil spill, the CVM study employed ex ante regulatory approach. That means the survey asked the respondents what they would be willing to pay for programs to prevent oil spills in the future, although responsible parties are not responsible for oil spill prevention and rather liability is for specific natural resource injuries resulting from the Nestucca spill incident. Hence, the ex ante regulatory approach may lead respondents to consider what they would pay for these programs, rather than the specific losses from injuries to natural resources caused by a particular spill.

In the survey Version 2, the following summary of an actual oil spill that occurred a few years ago (the Nestucca spill, which was not named) is presented, indicated as occurring about every five years:

- Occurred during the winter in the area presented by map in the survey.
- Killed about 40,000 seabirds, mostly Murres, Auklets and Murrelets.
- May have killed two sea otters, but this is not certain.
- Affected few, if any, fish and other forms of sea life.
- Oiled about 200 miles of shoreline along Washington and Vancouver Island.
- Rough seas cleaned the shoreline within a few months.
- Occurred in heavy seas when a barge lost control. But, the spill may have been prevented with additional oil spill prevention programs.

However, the researchers cannot be certain that it is these impacts that respondents are valuing, rather than oil spills and the programs themselves. Rather, the responses to requests for open-ended comments indicate that many people clearly think of spill prevention as a separate entity from avoidance of the specific natural resource impacts. Indeed, some indicated that specific impacts of spills were completely irrelevant to their valuation of the proposed programs to prevent spills. These responses clearly signal that respondents are focusing on the causes and prevention of spills and on ethical concerns regarding perceptions of carelessness, not on the specific losses of natural resources for which responsible parties are liable.

In addition, the other issue related to the survey is whether respondents have well quantified damages from a particular spill incident in dollar value. Natural resource damages due to the Nestucca oil spill include not only effects on

commercial fisheries and other aquatic life, but also oiled beaches, the death of a substantial number of seabirds, and sea otter mortality. The lost passive use value like the death of seabirds and sea otter mortality cannot be estimated directly in commercial markets and, as a result, should be estimated by CVM which is the only viable method for estimating passive use value. However, even the literature on CVM admits that most of respondents have never had an experience to estimate the economic value of natural resources and may not have well defined dollar values for them. In the survey, it is not likely that respondents have well quantified damages from a particular spill incident in dollar value.

Ⅳ. Funding Environmental Restoration Projects

1. Actual Compensation for Environmental Damages from Nestucca Spill

U.S. and Canada Governments and the Nuu-Chah-Nulth First Nation filed suit in U.S. Federal Court to recover the costs of cleanup and related expenses, and for damages to the environment. The barge owners, *Sause Brothers Ocean Towing*, sought to limit their liability. The case was heard in U.S. District Court in the company's home state of Oregon.

According to the results of CVM study performed by RCG/Hagler, Bailly, Inc., damages per British Columbia household due to the Nestucca spill were estimated to range from $45 to $175, with a central estimate of $80 in 1990 Canadian dollars, as suggested in Table 1. The implied total damages to British Columbia can be estimated by applying damage per household to all British Columbia households. This results in a central estimate of damages of about $80 million to British Columbia (Grigalunas and Opaluch, 1993).

Sause Brothers and their insurers, the P&I Club, strongly resisted paying the cleanup costs as well as environment damages. Eventually the Court ordered the parties to meet with a District Court Judge and attempt to achieve an out-of-court settlement. In 1993, after negotiations, the parties came to an agreement approved by the Court. This gave Canada compensation for full cleanup costs of $4.4 million and an additional $4.3 million went to the federal government of Canada and the provincial government of British Columbia to be used for environmental damage restoration. The Nuu-Chah-Nulth First Nation received $700,000 for the loss to commercial fisheries.

2. Funding Restoration Projects by Using Compensation Money

The federal government of Canada and the provincial government of British Columbia jointly received $4.3 million compensation money for environmental damages resulting from Nestucca oil spill. Based on the compensation money, both parties established the *Nestucca Oil Spill Trust Fund* and agreed that the money would be used to restore the environmental damages whatever jurisdiction (federal or provincial) was technically best. A Federal-Provincial Committee of biologists, under the Canada/British Columbia Wildlife Agreement, now administers the Nestucca Oil Spill Trust Fund and approves the restoration projects.

The primary criteria for funding restoration projects are that the projects are feasible and reasonable, and that they compensate for environmental damages done by the Nestucca oil spill to resources under the jurisdiction of Canada or British Columbia, as documented in various reports and in testimony to the courts. There are three categories of eligible projects. In order to priority they are:

a. Projects of physical restoration which will permit replacement of some of the natural resources injured in the spill.
b. Projects to replace some of the natural resources injured in the spill by preventing similar injuries in the future.
c. Projects of research and inventory leading to better understanding of how to prevent future injury to some of the natural resources injured in the spill.

The project funded in the first category is predator control on Langara Island. This is a large island near the Queen Charlotte Islands, north of the spill site, which in historical times supported populations of seabirds of the same order of magnitude as were killed in the Nestucca oil spill. After European settlement, shipwrecks introduced rats to the island which almost completely destroyed the seabird colonies. The proposal was to eradicate the rats by poison, allowing seabird populations to rebuild. The project would also extend the breeding range of some species over a wider area, making them less susceptible to future oil spills. After three years of planning and research, the eradication took place in 1995 and to date the project appears successful. The other projects in the second and third category have much less direct impact on the species injured. Funded projects include contingency planning and sensitivity mapping which may prevent future injuries, and basic research on the biota of the area where the spill occurred.

For Canada, the Nestucca case established it is possible to do environmental

damage assessment and restoration in oil spills. It freed up millions of dollars for environmental damage restoration that otherwise would not be available. In the Nestucca case, it was recognized that it is legitimate for the federal and local governments to use damages, paid in money, to mitigate environmental damages. This is a reflection of changing values and attitudes about the assessment and restoration of environmental damages in Canada since the Nestucca oil spill incident (Pond, 1997).

After the Nestucca case, another example of funding the environmental restoration project by using the compensation money is the oil spill incident from a collision between two ships in Vancouver Harbor in 1990. Resulting from the incident, 75 birds were dead and an additional 33 of 277 birds sent for cleanup died. In January 1992, the ship owner paid $10,000 in settlement of the claim for environmental damages to the claimant, the Vancouver Port Corporation(VPC). The VPC put aside the compensation money to be used for wildlife restoration in future oil spills in the port area. Environment Canada will certify the items to be paid for: this will usually be out-of-pocket expenses by volunteers for oiled bird cleanup.

In Korea, we also have been recovering money for restoring environmental damages since the Sea Prince oil spill occurred in 1995. Due to Faye, which was described as the worst typhoon to hit the Korean peninsula in 37 years, the 140,000 ton tanker Sea Prince whose owner was Hoyu Tanker Co., LTD ran aground. As a result of the grounding, about 5,000 ton bunker fuel and cargo out of 85,000 tons crude oil were spilled into the sea around Yochon, one of many small islands off the coast of the city of Yosu on the southern tip of South Korea. This incident badly contaminated shores and aquaculture near Yosu. It also affected several fisheries such as vessel fishing, set nets fisheries, anchovy drag nets fisheries, coastal stow nets fisheries in that area. It turned out to be the largest oil pollution case to have occurred in Korean waters.

The Yosu Fishermen's Cooperative tried to settle the damage to the commercial fisheries in the affected area for $68.8 million with IOPC Fund. However, the Yosu Fishermen's Cooperative was paid only $7.2 million in settlement of the claim for the damage to the local fisheries. In the other hand, the representatives of the local fishermen and LG-Caltex Oil, the holding company of the polluter Hoyu Tanker Co., LTD, came to an agreement whereby LG-Caltex Oil would support a variety of environmental damage restoration projects by paying an additional $5.7 million for indirect compensation. Most of the compensation money was used for the local

fisheries development projects like cleaning up fishing ground, stocking the coastal water with millions of fry, and building a center for culturing seeds affiliated to Yosu National University. In comparison to the Nestucca case in Canada, the much smaller part of the compensation money was used for environmental restoration projects in the affected area for the reason that they could not directly contribute to creating additional value for commercial fisheries. Therefore, the lesson that environmental policy makers in Korea have to learn from Canadian experience in environmental damages and restoration is that we need to put up a significant part of compensation money for an environmental restoration fund in order to protect our valuable environmental resources such as clean water, clean beaches, seabirds, etc.

V. Summary and Conclusions

This paper examines the basic issues that must be resolved in any successful application of a theoretical model such as contingent valuation method to estimating the economic costs of natural resource damages due to oil spill incidents and investigate the Canadian experience in funding environmental damage restoration projects by using compensation money for the environmental damages. To complement its objective, the paper provides a discussion of the economic theory of NRDA and discusses the mechanics and validity of CVM for quantifying environmental damages in monetary terms. Then, the paper also reviews a case study of using CVM to estimate environmental damages resulting from the 1988 Nestucca oil spill, performed by RCG/Hagler, Baily, Inc.

There are two main schools of thought on what properly constitutes environmental damages. One is represented in international law and conventions on pollution damage. The other is represented in U.S. law. Canada is a member of and party to the international regime for addressing claims arising from oil spills caused by tankers laden with cargoes of persistent oils. The framework of the international regime was originally the 1969 CLC and 1971 Fund Convention. The IOPC Fund was established in 1978 after the Fund Convention came into force. Compared with U.S. regime under the Oil Pollution Act of 1990 (OPA '90), the IOPC Fund has traditionally limited claims for restoring the environmental damages. However, in 1992, both the CLC and the Fund Convention were modified by Protocols which dealt, in part, with environmental damages. Since the 1992

Conventions entered into force in 1996, the IOPC Fund now appears more receptive to payment for environmental damages than it was before.

In order for claims for the cost of measures to reinstate the marine environment to be admissible for compensation under 1992 Fund Convention, the measures should fulfil the following criteria:

- the cost of the measures should be reasonable
- the cost of the measures should not be disproportionate to the results achieved or the results which could reasonably be expected
- the measures should be appropriate and offer a reasonable prospect of success.

There is also a longstanding IOPC Fund policy that the assessment of compensation is not to be made on the basis of an abstract quantification of damage calculated in accordance with theoretical models such as CVM. In contrast, U.S. regime has deemed that compensation is due for lost environmental values when restoration is impossible and accepts that the monetary value of those damage can be assessed not only by traditional means but by the theoretical models such as CVM and computerized techniques. The practical implication of this comparison is that the scope for payment for environmental damages is much more limited under the international regime than the U.S. regime.

In the case of Canada, there is no general legislative authority requiring compensation for environmental damages. However, there are specific pieces of legislation already existing which allow for some restoration and compensation for some specific damages. These include the Canada Shipping Act (CSA), the Fisheries Act (FA), and the Canadian Environmental Protection Act (CEPA). So far, the attempts to recover compensation for environmental damage are scare in Canada. The first Canadian example was the Nestucca oil spill used in the case study of this paper. For Canada, the Nestucca case established it is possible to do environmental damage assessment and restoration in oil spills. From the viewpoint of an economist, the lessons from the Nestucca oil spill suggest that, in order to improve the ability to quantify environmental damages in monetary terms, the theoretical and practical framework of an environmental damages assessment and restoration process should be developed further in the future.

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유류해양오염으로 인한 환경피해에 대한 경제적 가치평가 : 캐나다의 유류해양오염에 대한 사례연구

정 형 찬

Abstract

유류오염 사고를 사전에 예방할 수 있는 정책 수단으로는 여러 가지가 있지만 주요한 것으로는 인센티브제의 활용을 들 수 있다. 유류오염 사고를 예방하고 관리하기 위한 인센티브는 유출 사고로 인해 발생한 해양자원의 피해에 대해 가해자에게 배상책임(liability for losses due to spills)을 부과함으로써 제공될 수 있다. 유류오염 사고로 인한 피해액을 실제 화폐단위로 계량화하는 작업은 배상책임 부과제도를 정책수단으로 활용하기 위해 해결해야 할 가장 어려운 과제이다.

따라서, 최근 미국과 캐나다를 중심으로 발전하고 있는 자연자원 피해에 대한 가치 평가법(Natural Resource Damage Assessment : NRDA)은 배상책임 부과제도를 정책적으로 보완할 수 있는 이론적 도구로 간주되고 있다. NRDA는 잠재적인 가해자들에게 그들이 자연환경을 보존해야 하는 사회적 의무를 이행하지 못하고 이를 훼손하게 될 때 이로 인해 발생하는 모든 사회적 비용을 직접 부담해야 한다는 명확한 재무적 인센티브(financial incentive)를 부여함으로써 가해자 보상 원칙 (polluter pays principle)을 실현할 수 있게 한다.

본 연구는, 유류오염 사고로 인한 환경자원 피해의 경제적 가치를 추정하는 가장 중요한 이론적 모형으로 활용되고 있는 가상상황평가법(CVM)에 대한 기초 개념과 이론적 체계, 그리고 이를 실제 피해액 추정에 성공적으로 적용시키기 위해 해결해야 할 문제점 등을 다루었다. 이를 위해, 본 연구에서는 1988년 캐나다 북서부 연안에서 발생한 Nestucca 유류오염 사고를 사례연구의 대상으로 선정하고, 사고 당시 캐나다 연방정부와 British Columbia 주정부를 대신하여 해양오염에 의한 환경피해의 경제적 가치를 추정한 미국의 컨설팅 회사인 RCG/Hagler, Baily Inc.의 가상상황평가법(CVM) 적용 사례를 분석 검토하였다. Nestucca 사례연구에서는 이들 연구자들이 실제로 활용한 설문지 설계, 설문방법 및 표본설계 등을 분석하였으며, 또한 CVM이 본질적으로 갖고 있는 방법론적 문제점들을 연구자들이 어떻게 해결하려고 했는가를 고찰하였다. 그리고, WTP 추정을 위해 RCG 연구자들이 사용한 사전규제접근법(ex ante regulatory approach)으로 인해 야기될 수 있는 환경자원 피해액 추정 방법의 한계점도 함께 검토하였다.

캐나다 연방정부와 British Columbia 주정부는 Nestucca 유류오염 사고로 인한 자연자원 피해에 대한 손해배상으로 $4.3 Million의 보상금을 지급 받게 된다. 캐나다 정부는 이 보상금으로 Nestucca Oil Spill Trust Fund를 설립하여 피해를 입은 자연자원의 원상회복(restoration)을 위한 다양한 연구 프로젝트에 자금을 지원하고 있다. Nestucca 유

류오염 사고를 계기로 캐나다 정부와 학계는 해양자원의 피해에 대한 경제적 가치평가와 자원의 원상회복에 대한 체계적인 접근 방안을 처음으로 마련 시행하게 되었다는 점에서, Nestucca 유류오염 사고에 대한 사례연구는 캐나다의 해양환경 보존 정책을 연구하는 출발점으로 평가될 수 있을 것이다. 이에 비해, 우리나라에서 대표적인 유류오염사고로 알려져 있는 시프린스호 사고와 관련된 손해배상금은 주로 연안어민들의 어업피해 배상으로 이루어져 있으며, 간접피해에 대한 배상액 48억 5천만원도 대부분 치어방류, 여수대학교 종묘배양장건립 등 피해지역 연안어업 발전을 위한 사업에 투자되었다.

Key word : Oil spill damages, NRDA, Environmental Restoration