How Two Non-Market Valuation Techniques Can Improve Compliance with Environmental Justice Requirements: Three Case Studies Using Hedonic Property and Contingent Valuation Methods to Quantify the Distribution of Benefits by Ethnicity and Income

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ABSTRACT

This paper demonstrates how two non-market valuation techniques can be used to monetize the absolute and relative distribution of benefits from environmental programs to minorities and low income populations. These techniques could provide a valuable supplement to current descriptive or qualitative assessments of Environmental Justice that characterize current agency practices. After defining economic benefits, we show how the Hedonic Property Method (HPM) and Contingent Valuation Methods (CVM) can be adapted to test for differences in the distribution of benefits between minority groups and income classes. We examine three case studies that provide empirical examples of how the HPM and CVM can provide estimates of the distribution of monetary economic benefits: (a) by differential effects on house prices in minority neighborhoods from forest fires; (b) by income class for maintaining instream flow in an urban area; (c) by ethnic group, i.e., African Americans, Hispanics, Native Americans and Whites for reducing forest fires throughout the states of California, Florida and Montana. Regarding the CVM case study of forest fires, we find differences in benefits between Whites and the different ethnic groups averages 36% in our data. The distribution of monetary benefits can then be compared to the distribution of the tax burden necessary to finance these programs in order to arrive at the distribution of net benefits (i.e., benefits minus tax costs) of these programs. This type of information should improve the thoroughness of Environmental Justice analysis and complement the existing qualitative and descriptive analyses.
Introduction

In response to perceived inequities in the distribution of environmental effects on racial minorities and low income households, President Clinton issued Executive Order (EO) 12898 in February 1994. Section 1-101 of the EO requires “…each Federal agency shall develop an agency-wide environmental justice strategy, … that identifies and addresses disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.

Section 6-606 of the EO states that: “Each Federal agency responsibility set forth under this order shall apply equally to Native American programs.”

Implementation of this EO includes the inclusion of an Environmental Justice section in Environmental Impact Statements (EIS’s) performed under the National Environmental Policy Act (NEPA) (Bass, 1998). As is typical in the administration and implementation of new procedural requirements, the federal agencies have significant discretion in identifying and addressing disproportionately high and adverse environmental effects of its programs or activities on minority and low income populations. The experience of this author in helping the Bureau of Land Management (BLM) prepare such a section for the EIS on one of its Resource Management Plans (RMP’s) in Colorado suggests the agency procedures are quite permissive. The identification was limited to documenting what percentage of the population was minority and low income, along with a discussion of whether any job losses associated with one land management alternative might affect these populations.

Additionally the author has participated as an instructor in BLM’s social and economic training course for BLM employees preparing EIS’s on RMP’s. The training course materials for addressing Environmental Justice indicate that while it is easy to describe minority and low income populations with Census data, it is more difficult to identify and assess impacts. The course materials suggest that some type of qualitative assessment should be made, but little guidance is presented on how to do this or what methods might be appropriate.

In the U.S. Environmental Protection Agency’s (EPA) “Guidelines for Preparing Economic Analysis” (USEPA, 2000), there is a brief discussion of Environmental Justice issues in Chapter
9: Distributional Issues. The Guidelines call for determination of whether environmental effects of changes in the natural or physical environment are adverse and disproportionately high to minority and low income populations (USEPA, 2000: 166). The disproportionately high standard is relative to effects on the general population. This discussion is aimed towards determining health risks of environmental effects using just quantitative units such as risk levels or acres rather than monetary estimates.

These limitations to existing approaches that compare benefits of government programs or regulations to clean up the environment, suggests it would be worthwhile to have an additional tool to meet the requirements of EO12898 on Environmental Justice. I am not suggesting the economic valuation methods replace the non-monetary quantitative measures such as risk levels, or qualitative and descriptive discussions of impact since monetary measures may be incomplete in and of themselves. Thus these other qualitative methods provide a more complete discussion and provide context to the monetary measures. But monetary measures may play an important role in allowing distributional concerns to better influence policy discussions. For example, some clean up programs may have total costs in excess of total benefits for society as a whole, but might have benefits in excess of costs for minority populations because these minority populations are disproportionately exposed to the pollutant and would pay little of the costs, if for example they are financed from income taxes. Thus there would be positive net benefits of this program to minorities, information which may be useful for decision makers.

An Economic Approach to Addressing Environmental Justice

EO 12898 focuses on health effects as well as environmental effects of federal government programs on minority and low income populations. To more quantitatively address health and environmental effects we suggest that analysts draw upon economic methods developed to monetize benefits of environmental quality and the costs of pollution. Some methods are quite simplistic and measure just medical treatment costs. Other more sophisticated techniques look at the “pain and suffering” or loss of well being that people experience due to reductions in health resulting from air and water pollution, even if no medical costs are incurred. These losses of well being include “restricted activity days” when a person is too sick or ill-advised to go outside due to high levels of air pollution for example. The knowledge of how these environmental costs are
distributed among different segments of the population and income groups would go a long way to quantifying whether a government policy that permits a new pollution sources would disproportionately affect minorities and low income households.

On the financial cost side, well known principles of public finance would aid in identifying if the financing mechanism for the environmental quality improvement programs would have a regressive, proportional or progress tax incidence. Cross tabulating income with ethnicity would allow identification of how the tax burden would be distributed across minorities, providing further evidence of whether the costs environmental quality improvement programs fell disproportionately on minority groups.

An economic analysis of the distribution of pollution costs and benefits from pollution reduction can be performed using several economic valuation techniques. Some rely upon actual behavior such as house price differentials or wage differentials associated with cleaner or dirtier environments, i.e., hedonic methods (Taylor, 2003). In other cases, a simulated market or referendum can be constructed to directly ask what people would pay to avoid air pollution episodes that cause adverse health symptoms or “restricted activity days” (Mitchell and Carson, 1989; Boyle, 2003).

**Defining Economic Benefits**

Economic principles and United States federal government benefit-cost guidelines define economic benefits as the amount of money a consumer would pay for a particular improvement in environmental quality (U.S. Water Resources Council, 1983; USEPA, 2000). The short hand term is “willingness to pay” or WTP. However, WTP is just a short hand for willingness and ability to pay, as households are constrained by income in their WTP. For reductions in environmental quality, the conceptually correct measure of value is willingness to accept or WTA if households have a property right to the current level of environmental quality. The WTA measure is not bounded by income. In principle, for many environmental goods involving aesthetics such as water clarity in lakes or visibility or recreational activities, WTA and WTP are expected to be quite similar. In these examples, the value of the goods makes up a small portion of income, making the “income effects” so small that there should be little difference between
WTA and WTP. However, for pollution affecting human health, WTA can substantially exceed WTP. Unfortunately attempting to obtain theoretically consistent empirical measures of WTA from survey data has proven difficult, and the recommendation to federal agencies is to approximate WTA with WTP, and note the conservative nature of WTP (Arrow, et al., 1993). When using WTP, one way to adjust for likely different incomes of minorities and low income households would be to compare WTP as a percent of income.

Types of Economic Benefits

For many changes in environmental quality the individual’s WTP relates to their direct use of the environmental quality. For example, improving drinking water quality directly improves human health and sometimes the taste and appearance of the drinking water too. Improving water quality in a river or a lake to support game fish, such as trout, also has a direct use value by improving the quality of recreational fishing to anglers.

However, there are some unique natural resources or unique natural environments from which individuals may indirectly receive utility from just knowing these resources exist in their natural setting or knowing that protection today provides a bequest of these resources to future generations. Those individuals have a WTP motivated by what economists called existence and bequest value (Krutilla, 1967; Freeman 1993). The United States government recognizes these existence and bequest values as part of economic damages associated with oil spills and other natural resource damages associated with pollution from mines for example. The United States Court of Appeals in Washington DC coined the term “passive use value” in upholding the inclusion of existence value in natural resource damage assessments (U.S. District Court of Appeals, State of Ohio v. U.S. Department of Interior, 1989). In principle, the effects on minorities and low income populations’ direct use and passive use values should be included when performing an environmental justice analysis.

Economic Methods to Monetize WTP for Direct Use and Passive Use Values

Economic methods to quantify WTP can be separated into revealed preference methods based on actual behavior and stated preferences based on intended behavior. Revealed preference methods can only estimate use value, as these methods infer the households WTP for environmental
quality by how purchases of related market goods needed to consume environmental quality varies with levels of environmental quality. Stated preference methods use surveys to elicit WTP. Households are asked their WTP for their own use or for passive use values for resources or natural environments they have not visited nor plan on visiting.

The hedonic property method is an example of a revealed preference method suited to quantifying the effects of improvements or reductions in environmental quality on minorities and low income households. As described in more detail below, this method uses differences in house prices in areas with good environmental quality (e.g., less air pollution) and areas with poor environmental quality (e.g., more air pollution) to infer households WTP for improving environmental quality. This WTP for improving environmental quality is a direct use value as the environmental quality is directly consumed by the household on site.

WTP can also be elicited by constructing a simulated market or voter referendum to ask what people would pay if such a market existed. These techniques are known as the Contingent Valuation Method (CVM, see Boyle, 2003) or Choice Experiments (CE, see Holmes and Adamowicz, 2003). Similar techniques exist in the marketing literature and are called conjoint analysis (Louviere, 1988). CVM involves a survey describing to the respondent: (1) the current level of environmental quality; (2) a program to increase environmental quality; (3) the magnitude of the increase, and (4) how they would pay for it. They are then asked either the maximum amount they would pay, or more recently, whether they would vote in favor of the program at a cost per household that varies across the households. If they vote against the improvement program, they stay at the current level of environmental quality.

CVM has been recommended by the United States government for monetizing recreation benefits since 1979 (U.S. Water Resources Council, 1983). It has only been in the last 15 years, that CVM has been recommended by the United States government for quantifying passive use or existence values. The U.S. National Oceanic and Atmospheric Administration (NOAA) convened a “blue ribbon panel” chaired by two Nobel Laureates in economics. The panel suggested that CVM could be used to produce estimates of use and passive use value suitable for administrative and judicial decision making (Arrow, et al., 1993).
In what follows we discuss how the Hedonic Property Method (HPM) and CVM can be applied to monetize the distribution of benefits to different minority and low income populations. We empirically illustrate this using a HPM case study and two CVM studies. One CVM study examines the benefits of reducing wildland urban interface fires in California, Florida and Montana to Hispanics and Whites in California and Florida, and for Whites and Native Americans in Montana. The other will show how the benefits of instream flow in an urban area varies with income.

How the Hedonic Property Method Can Aid in Quantifying Environmental Justice Impacts

The Hedonic Property Method or HPM relies on a spatial market. This market provides information on how house prices vary with levels of environmental quality, holding other features of the house or neighborhood constant. Using house price sale data, HPM can estimate the absolute change in house prices related to changes in environmental quality. HPM can also estimate the percentage change in house prices from an improvement in environmental quality. Comparing the percentage change in house prices would allow comparisons of impacts that would adjust for any differences in house prices of minorities or low income residents relative to the general population.

The HPM uses multiple regression to quantify how house prices fall with proximity to a waste site or source of pollution or adverse land use (e.g., landfill, oil refinery). A variable for distance to the pollution source is one way to measure the effect of pollution on house prices. If minority or low income households are located closer to these pollution sources, the relative adverse effect of the pollution source on house prices would be substantially greater on these nearby houses than would be the effect on houses located further away. For example, if house prices in a minority neighborhood located a half a mile from the pollution source are 20% lower than house prices in a non-minority neighborhood located two miles away from the pollution source, then one might conclude the environmental costs of this pollution source are disproportionately borne by nearby minority residents. However, on the flip side, a government clean-up program or order to the owner of the pollution source to reduce emissions would provide a disproportionate benefit to minority households, a desirable distributional effect, since minority owned houses would rise in value by 20%.
The strength of HPM is its utilization of actual market data on house prices to infer WTP for reducing pollution. In order to determine how much of the house price is related to pollution versus the features of the house (e.g., number of bedrooms, bathrooms, lot size) and locational attributes (e.g., distance to work centers, recreation, and school quality), a multivariate relationship is specified of the form:

$$\text{(1)} \quad \text{P} = \text{func (E, S, N)}$$

Where P is the house price, E are the location specific environmental attributes such as distance to landfills, or refineries or localized pollution concentrations in the area if the monitoring stations are of sufficient number to provide a fine resolution. 
S are the house characteristics noted above
N are neighborhood social and demographic variables such as percent non-white, income, education levels. These are typically tied to zip code or Census Tract.

As shown in equation (2) it is by interacting the minority variable or income variable with the measures of pollution that an analyst could determine if the effect of the environmental pollution on house prices varies for minority or low income households. Equation (2) provides an example of such a specification:

$$\text{(2)} \quad \log(\text{Real Sale Amount}) = \beta_0 + \beta_1 \ast (\text{Distance to Refinery}) + \beta_2 \ast (\text{Square Feet of House}) + \beta_3 \ast (\text{Median Household Income}) + \beta_4 \ast (\text{Distance to Refinery} \ast \text{Median Household Income}) + \beta_5 \ast (\% \text{ Non White}) + \beta_6 \ast (\% \text{ Non White} \ast \text{Distance to Refinery}) + \ldots$$

From this model the coefficient $\beta_1$ indicates how house prices increase as the distance the house is located from the refinery increases (since pollution would decrease). Whether that house price increase is different for houses located in low income neighborhoods would be tested by whether the interaction term on $\beta_4$ is significantly different from zero. The same test on $\beta_6$ would indicate whether there is a differential effect on house price increase for minority neighborhoods.

Using the coefficients (the $\beta$’s) in equation (2) an analyst can calculate the dollar change in house prices related to changes in environmental quality. This dollar change can be standardized into a the percentage change in house prices making a more relative comparison that adjust for
different house price values of minorities or low income residents relative to the general population.

Thus, HPM provides an economic model monetizing the distribution of pollution costs or clean up benefits to minority or low income populations in urban areas. While the HPM is typically estimated on residential housing (e.g. single family homes), it has been applied to rents at rental properties such as apartments.

Example of Hedonic Property Value Analysis of the Effect of Nearby Forest Fires on Hispanic and Low Income Residents Home Prices

House price sales data was collected in the foothills region of Los Angeles including high income areas such as Pasadena and lower income areas such as San Fernando. Both of these areas were near two different, but equivalent size fires. House Sale Amount is hypothesized to be related to:

- Distance the house is from the forest fire (which is treated as our hazard)
- Square footage of the house
- Percent of the Census block that is Hispanic,
- Interaction of percent Hispanic with Distance to the Fire (to test for a differential effect of distance of forest fire on neighborhoods that have a higher percentage of Hispanics)
- Median Household Income of the Census block
- Interaction of Median Household Income with Distance to the Fire (to test for differential effect of distance to forest fire by income).

Three environmental control variables are included:
- Distance to U.S. Forest Service land (i.e., National Forest),
- Distance to City of Los Angeles (the major employment center),
- Elevation above sea level.

Equation 3 provides the multiple regression that is used to estimate the $\beta$’s:

(3) $\log(\text{House Sale Amount}) = \beta_0 + \beta_1*(\text{Distance to Fire}) + \beta_2*(\text{House Square Footage}) - \beta_3*(\% \text{ Hispanic}) + \beta_4*(\% \text{ Hispanic} \times \text{Distance to Fire}) + \beta_5*(\text{Median Household Income}) + \beta_6*(\text{Median Household Income} \times \text{Distance to Fire}) + \beta_7*(\text{Distance to U.S.F.S. Land}) + \beta_8*(\text{Distance to Los Angeles}) + \beta_9*(\text{Elevation})$
The slope coefficient $\beta_1$ is the baseline increase in house price as distance from the forest fire area increases. Statistical differences from the baseline effect of a forest fire on house prices between White and Hispanic neighborhoods would be tested by whether $\beta_4$ is significantly different from zero using a t-test. The same t-test is employed on $\beta_6$ to determine if the effect of a forest fire varies with income.

The R-squared in Table 1 indicates the model explains 50% of the variation in house prices in this area of Southern California. The house square footage is statistically significant and of the expected sign (e.g., as house square footage increases, house prices increase). The Hispanic-Distance to Fire interaction term is statistically significant and negative. This suggests that houses prices in neighborhoods with a higher percent Hispanic populations have a significantly (p<1%) different magnitude of response than White neighborhoods to nearby forest fires. The same pattern is evident with respect to low income neighborhoods. That is, the house price response to a nearby forest fire in low income neighborhoods is statistically different (p<1%) than house price response in higher income neighborhoods.

### Table 1. Relationship between House Prices and Distance to Forest Fires, Hispanics and Income

<table>
<thead>
<tr>
<th>Dependent Variable: Log House Sale Price</th>
<th>Method: Least Squares</th>
<th>Observations: 7664</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Coefficient</td>
<td>Std. Error</td>
</tr>
<tr>
<td>Constant</td>
<td>11.50900</td>
<td>0.2183</td>
</tr>
<tr>
<td>Log(Distance to Fire)</td>
<td>0.087687</td>
<td>0.0272</td>
</tr>
<tr>
<td>Elevation</td>
<td>-0.00023</td>
<td>1.38E-05</td>
</tr>
<tr>
<td>House Sq Feet</td>
<td>0.00032</td>
<td>5.84E-06</td>
</tr>
<tr>
<td>% Hispanics</td>
<td>-0.00347</td>
<td>0.0005</td>
</tr>
<tr>
<td>%Hisp* Distance to Fire</td>
<td>-5.59E-07</td>
<td>1.97E-07</td>
</tr>
<tr>
<td>Household Income</td>
<td>4.00E-06</td>
<td>4.22E-07</td>
</tr>
<tr>
<td>Income*Distance to Fire</td>
<td>-5.77E-10</td>
<td>1.31E-10</td>
</tr>
<tr>
<td>Distance to USFS Land</td>
<td>-1.19E-05</td>
<td>3.73E-06</td>
</tr>
<tr>
<td>Distance to Los Angeles</td>
<td>-1.63E-06</td>
<td>4.82E-07</td>
</tr>
</tbody>
</table>

| R-squared                               | 0.508       | Mean dependent var | 12.38563 |
| Adjusted R-squared                      | 0.507       | S.D. dependent var  | 0.48238  |
| F-statistic                             | 879.500     | Prob(F-statistic)  | 0.00000  |

However, statistically significant differences are only part of the story. Whether those differences are economically significant is equally important. We can convert the coefficients to an absolute change in house price by multiplying the coefficient times mean house price ($239,338 in 1993 prices). Thus houses in White neighborhoods adjacent to a forest fire are worth $7,884 less than
houses a mile away, holding all other factors constant. This is due homebuyers’ perceived higher risk being close to an area with forest fires. However, for Hispanic neighborhoods in our data set (25% Hispanic) adjacent to an area that has experienced a forest fire, the reduction in house price is smaller at $4,539 less than houses a mile away, 54% less effect than that of White neighborhoods. Considering house prices in predominantly Hispanic neighborhoods sell for less ($218,533, as our coefficient on percent Hispanic suggests), the percentage drop in house price next to the fire represents a 2% loss in house price for Hispanic neighborhoods versus 3.3% for White neighborhoods. Similar calculations for lower income neighborhoods show that low income neighborhoods (those with incomes $20,000 less than our median) would lose $5,212 by being adjacent to a fire versus a mile away. This too is smaller than the drop in house prices of median income neighborhoods.

This hedonic property analysis results can be utilized in two different ways. First, the impact of a Federal government “let it burn” policy that has been applied to naturally started forest fires (e.g., lightening), especially those in Wilderness areas (some of which are adjacent to Wildland Urban Interface areas) would not have an Environmental Justice concern. Specifically, the absolute and percentage loss in house prices from being adjacent to a forest fire, is about half for minority and low income neighborhoods compared with White and median income neighborhoods. On the flip side, government agency expenditures on fuel reduction projects that would reduce forest fires adjacent to White and Hispanic neighborhoods, would yield larger absolute and percentage gains in value in White neighborhoods than in Hispanic neighborhoods. This might raise environmental justice concerns depending on how the government fuel reduction programs were financed. Nonetheless, this example illustrates how the Hedonic Property Method can be used to evaluate the absolute and relative effects of forest fire management decisions on minority and low income households.

Contingent Valuation Method

The contingent valuation method (CVM) uses survey techniques to elicit values for nonmarket goods or services. This survey or interview elicitation process is necessary because there is a lack of explicit and observable market forces for geographically widespread public goods. Examples of widespread public goods range from global climate change to improving an entire
city’s drinking water quality or reducing forest fire smoke affecting city residents. There are certainly some concerns about the reliability of CVM estimates of WTP, and the accuracy or validity of WTP results (see Mitchell and Carson, 1989). However, empirical test-retest studies have demonstrated CVM WTP estimates to be reliable (Loomis 1989, 1990). It is worth noting that even if there is an upward bias in the self reported benefit estimates provided by CVM surveys, as long as the bias is of similar magnitude across the different ethnic minorities and income levels, the relative distribution of benefits can still be quantitatively assessed using percentage differences in WTP by minority group or income level. If there is a concern about differences in income between minority and White households, comparisons could be made based on the percentage of income each group would pay for the policy or program.

Since CVM is used to estimate economic benefits it is well suited to monetizing the effect on minorities and low income households relative to the general population. CVM can do this because the CVM surveys also ask demographic questions such as ethnicity and income. Therefore calculating the distribution of economic benefits or costs by ethnicity and income levels is quite feasible. For example, if an open-ended WTP question format is used (i.e., what is the most you would pay to reduce nitrates in your drinking water from 20 ppm, which is higher than what EPA considers safe, to 8ppm which is below the EPA standard), then the resulting monetary amounts can be disaggregated by income and ethnicity.

Example of Using CVM to Estimate How Benefits of River Flows Vary by Income
A mail survey of Fort Collins residents was conducted in the Fall of 2007. The survey had a relatively high response rate of 65% of deliverable surveys. Residents were asked the maximum amount they would pay annually to avoid a 50% reduction in peak flows. Visitors were asked the maximum they would pay for a visit to the river through town. Table 2 illustrates the distribution of total economic value (use plus passive use) and recreation benefits of maintaining peak May-July instream flows in the Poudre River through the City of Fort Collins, Colorado by income level. Respondents were told the current May-July flows would protect riparian vegetation as well as fish and bird populations. In addition, a paved bike path follows the river that thousands of residents use. During the high flow periods, the river provides locals with water based recreation opportunities such as tubing and fishing.
Table 2. Distribution of Total Economic Value and Recreation Value by Income

<table>
<thead>
<tr>
<th>Income</th>
<th>Total Economic Value (annual)</th>
<th>Recreation Value per trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>$7,500</td>
<td>$235</td>
<td>$3</td>
</tr>
<tr>
<td>$15,000</td>
<td>174</td>
<td>11</td>
</tr>
<tr>
<td>$25,000</td>
<td>85</td>
<td>6</td>
</tr>
<tr>
<td>$35,000</td>
<td>93</td>
<td>6</td>
</tr>
<tr>
<td>$45,000</td>
<td>73</td>
<td>13</td>
</tr>
<tr>
<td>$55,000</td>
<td>81</td>
<td>17</td>
</tr>
<tr>
<td>$68,000</td>
<td>125</td>
<td>9</td>
</tr>
<tr>
<td>$88,000</td>
<td>167</td>
<td>23</td>
</tr>
<tr>
<td>$125,000</td>
<td>144</td>
<td>10</td>
</tr>
<tr>
<td>$175,000</td>
<td>95</td>
<td>10</td>
</tr>
<tr>
<td>$250,000</td>
<td>90</td>
<td>6</td>
</tr>
<tr>
<td>$350,000</td>
<td>500</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Loomis, 2008.

As illustrated in Table 2, there is no real pattern of total economic values or recreation use values by income. This suggests that there would be no environmental justice concerns on the distribution of benefit side of this proposal.

Depending on how maintaining instream flows was financed there may be environmental justice concerns on the cost side however. To address the cost side, the field of public finance in economics can provide some insights. If maintaining instream flows was financed by increasing the sales tax rate, then such a regressive tax would pose environmental justice concerns for low income and minority households. If maintaining river flows was financed by increasing water bills, this may be less regressive than a sales tax, and therefore may be less of an environmental justice concern than sales taxes. If the instream flow program was financed by increasing property taxes, since house values rise with income, property taxes are likely to be at least proportional if not progressive, suggesting environmental equity concerns may be minimal.
CVM Case Study of Statewide Benefits of Reducing Forest Fires

Poor and minority households often bear a disproportionate amount of the damage from natural catastrophes such as floods, hurricanes and fires. The most recent major example was hurricane Katrina, where poor African-American neighborhoods bore the brunt of the damage, and African Americans were more likely to be displaced for long periods of time. The benefits of shoring up levees after Katrina, rebuilding houses, and chartering buses for evacuation would no doubt have positive environmental justice benefits.

Increasing numbers of catastrophic wildfires for the last several summers has brought forward legislation (Health Forests Restoration Act) and more active forest fuel reductions on National Forests that are nearby urban areas. Some of these areas are wealthy, but some are not, especially in Florida with retirees, some foothills areas of southern California, and Indian Reservations in Montana. Management actions include prescribed burning and mechanical fuel reduction programs such as forest thinning. A policy of accelerating the amount of land to be prescribed burned or mechanically thinned is not without opposition. Prescribed burning can generate smoke for one or two days, aggravating health problems for people with respiratory conditions. Prior initiatives to increase prescribed burning in Florida and Washington have often been limited by citizen opposition due to smoke and health effects. The prescribed burning program is also expensive and costs as much as $250 per acre or more in some parts of the country. However, these programs would reduce far worse long episodes of wildfire smoke.

In order to investigate the environmental justice implications of these fuel reduction programs we are interested in how the benefits of these two fuel reduction programs are distributed among Spanish speaking Hispanics and English speaking residents of California and Florida as well as Whites and Native Americans in Montana. The two wildfire fuel reduction programs under study are quite relevant to people living in California, Florida and Montana because of these states’ frequent wildfires. Large scale wildfires near cities generate very high levels of air pollution, adversely affecting health of residents and necessitating residents remain indoors or leave the city. This series of CVM studies, two of which were conducted in Spanish, illustrates how CVM can be used to quantify how monetary benefits of these fuel programs are distributed among minority groups identified in the Executive Order on Environmental Justice.
Survey Design

A survey booklet was developed in conjunction with forestry professionals in California, Florida and Montana to convey information on the extent of the problem and two possible programs to reduce the problem (i.e., prescribed burning and mechanical fuels reduction). Specifically, the survey booklet described the acreage that is burned by wildfires in an average year as well as the typical number of houses lost to wildfire each year. Next, a program increasing the use of prescribed fire or controlled burning in California, Florida or Montana was described. Specifically, respondents were told that the prescribed burning fuels reduction program would reduce potential wildfire fuels through periodic controlled burning. It was acknowledged that prescribed burning does create some smoke, although far less than a wildfire. Then the survey booklet provided additional information and drawings contrasting wildfire and prescribed fire. The cost of financing this prescribed burning program was described as a cost-share program between their state government and the county the individual lived in. The survey booklet was refined through focus groups in Florida and Montana, and pretesting in all three states.

WTP Question Format

The NOAA blue ribbon panel (Arrow, et al. 1993) recommended that CVM surveys be conducted using a dichotomous choice format, such as a voter referendum. In this format the individual is asked whether they would vote in favor or against a preset bid amount that varies across the sample. The voter referendum format is thought to simulate a realistic choice format that ordinary citizens are familiar with, and is considered better than other WTP question formats such as asking an open ended WTP question (Arrow et al. 1993). Given that the response to the referendum is either Yes in Favor or No Against, the dependent variable is coded either 1 or 0, respectively. As such a logistic regression is used to estimate the relationship between the respondent’s vote and the monetary amount they are asked to pay. Using the logistic regression coefficients the mean and median WTP can be calculated.

The WTP elicitation wording for California was:

“California is considering using some state revenue as matching funds to help counties finance fire prevention programs. If a majority of residents vote to pay the county share of this
program, the Expanded California Prescribed Burning program would be implemented in your county on federal, state, and private forest and rangelands. Funding the Program would require that all users of California’s forest and rangelands pay the additional costs of this program. ...If the Program was undertaken it is expected to reduce the number of acres of wildfires from the current average of 362,000 acres each year to about 272,500 acres, for a 25% reduction. The number of houses destroyed by wildfires is expected to be reduced from an average of 30 a year to about 12. Your share of the Expanded California Prescribed Burning program would cost your household $XX a year. If the Expanded Prescribed Burning Program were on the next ballot would you vote ___In favor ___Against?”

Identical wording was used in Florida and Montana, except the number of acres and numbers of houses burned were changed to correspond with particular state numbers. For example, in Florida, currently 200,000 acres burn and 43 houses are destroyed in an average year. With the proposed program this would be reduced to 150,000 acres and 25 houses. In Montana currently 140,000 acres burn and 20 houses are destroyed. With the program, this would be reduced to 105,000 acres and 8 houses, respectively.

The funding of both of these fuels treatment programs was explained as being on a county-by-county basis, where if a majority of the county residents voted for the program, the state would match funds for the approved counties and everyone in the county would be required to pay the additional stated amount for their county. The bid amount, denoted by $XX, varied across respondents and had the following values: $15, $25, $45, $65, $95, $125, $175, $260, $360, and $480.

Data Collection and Survey Mode

The survey was conducted through a phone-mail-phone process in all three states. To obtain a representative sample of households, random digit dialing of the households living in a sample of California, Florida and Montana counties was performed. Once initial contact was established, language was verified (except in Montana), and scheduling of appointments with individuals for detailed follow-up interviews were made. During the interim time period, a color survey booklet was mailed to the household. These interviews were conducted with the aid of this color
booklet. The booklet was sent in English to Whites and Native Americans, and in Spanish to Hispanic households. The individuals were asked to read the survey booklet prior to the phone interview. Phone interviews were conducted in either English or Spanish depending on the language of the booklet received.

Survey Response Rate
Because the survey was conducted in two waves, ethnic groups in California and Florida can be compared on response rates from the initial random digit dial phone survey and the follow-up in-depth interviews separately. The response rates to the initial phone calls were over 67% for all groups except Whites in California. A high response rate was obtained (75% for California and 85% in Florida) for Hispanics phoned by a Spanish-speaking interviewer. The extra effort to contact people in their native language was definitely worthwhile in the initial interview. However, in the second wave, the in-depth interviews over the phone using the survey booklet, the response rate for Hispanics in California decreased to 33%, well below those of other groups, which ranged from 61% to 73%. It may be that once the Hispanics saw the rather lengthy survey booklet they were less inclined than Whites to participate in the in-depth survey.

Results of the WTP Analysis
In order to focus on the distribution of benefits to each ethnic group relative to White households, we briefly summarize the key statistical relationships. Readers interested in viewing the detailed logistic regression results can see Loomis, et al. (2002), Loomis, et al (2005) and Gonzalez-Caban, et al. (2007).

There are two types of tests to determine if the benefits of wildfire reduction vary by ethnic group and income. The first is to include in the logistic regression equations variables indicating ethnicity (e.g., Hispanic, Black) as both intercept shift variables and interacted with the monetary bid amount. The second approach is to estimate separate logistic regressions for each group, and then calculate WTP for each group to see if the respective WTP are markedly different.

To illustrate the first approach, we pooled all California respondents to the prescribed burning program (i.e., Whites, African-Americans and Hispanics taking the survey in English, Hispanics
taking the survey in Spanish) and then included separate intercept variables and dollar price interaction variables in this single logistic regression equation. Making White households the baseline case, there are six possible combinations of intercept shifters and monetary price interaction variables: three ethnicity/language combinations each with an intercept shifter and dollar price interaction variable. Results from the logistic regression indicates that of these six coefficients, only one (Hispanics taking the survey in English interacted with the dollar amount) exhibited a statistically significant difference from White households. All the other intercept shifters and dollar price-ethnicity interaction terms showed no statistical difference in responses relative to those of White households. This suggests that, controlling for other variables such as education and any health effects from prescribed burning, there is not a systematic difference in the probability of voting for the prescribed burning program between Hispanics taking the survey in Spanish or African-American households and White households. It should also be noted that income was not statistically significant in this logistic regression, suggesting there was no difference in how households of different income levels voted.

The second approach to quantifying if there are different benefits to different minority groups is to estimate separate logistic regression equations for each group. Table 3 summarizes annual WTP per household calculated from these separate logistic regression equations. Across the three states (CA, FL and MT) and the two fuel reduction programs (prescribed burning and mechanical fuel reduction), and for Whites, African Americans (CA only), Hispanics and Native Americans (Montana only) we had a total of 16 separate logistic regression equations. The coefficient on the dollar price amount households were asked to pay were all negative, and statistically significant in 12 out of the 16 (75%), indicating the higher the monetary amount they are asked to pay, the lower the probability they would pay. This negative relationship between probability of Yes response and bid amount demonstrates internal validity of the results. From the 12 separate logit equations with a statistically significant negative bid amount we calculate mean annual WTP per household for 12 of these groups and programs. Table 3 presents the results of the mean WTP.

Comparing WTP between White and ethnic households within each state shows some differences in WTP for the prescribed burning and mechanical fuel reduction programs. In particular, WTP for prescribed burning in California between Whites and African Americans
differ by 26%. The moderately large difference is due in part to differences in demographics of Whites and African-Americans. The difference between Hispanics and Whites in Florida is double that at 52%. Comparing White and Native American households in Montana, their respective WTP also has a 22% difference.

Table 3. Mean WTP per Household & Percent Difference in WTP by Group for Prescribed Burning and Mechanical Fuels Reduction Programs in California, Florida & Montana

Prescribed Burning Fuel Reduction Program

<table>
<thead>
<tr>
<th></th>
<th>California</th>
<th>Florida</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WTP African Americans</strong></td>
<td>$505</td>
<td>$311</td>
<td>$135</td>
</tr>
<tr>
<td><strong>WTP Whites</strong></td>
<td>$400</td>
<td>$472</td>
<td>$174</td>
</tr>
<tr>
<td><strong>Percent Difference in WTP</strong></td>
<td>26%</td>
<td>52%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Mechanical Fuel Reduction Program

<table>
<thead>
<tr>
<th></th>
<th>California</th>
<th>Florida</th>
<th>Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WTP Hispanic-Spanish</strong></td>
<td>$863</td>
<td>$253</td>
<td>$306</td>
</tr>
<tr>
<td><strong>WTP Whites</strong></td>
<td>$437</td>
<td>$398</td>
<td>$286</td>
</tr>
<tr>
<td><strong>Percent Difference in WTP</strong></td>
<td>49%</td>
<td>57%</td>
<td>7%</td>
</tr>
</tbody>
</table>
For the mechanical fuel reduction program, the absolute and percent differences between ethnic groups and White households are quite large in California and Florida at 49% and 57%, respectively. However, the differences between Native Americans and Montana households are quite small at 7%.

Out of the six comparisons, about half the time the minority groups (e.g., African-Americans, Hispanics and Native Americans) have higher values than White households. White households tend to have higher values for prescribed burning (two out of three comparisons) while minority households appear to have higher values for mechanical fuel reduction such as thinning (two out of three) comparisons. Thus for prescribed burning in Florida, the 52% higher WTP of White households over Hispanics households might suggest White households receive disproportionately high benefits from the reduction in wildfire smoke. Likewise for the mechanical fuel reduction program in Florida. However, in California Hispanics benefits are 49% larger than White households indicating environmental justice is not likely to be of concern with that fuel reduction in California.

However, the most important lesson that can be drawn from Table 3 is that CVM is capable of quantifying how WTP or the benefits of these programs vary by ethnic group and by geographic area. These differences in benefits can be compared to differences in the tax burden associated with state income taxes and county property taxes needed to fund these programs, to arrive at an overall net benefit for each minority and relative to White households.

**Conclusion**

This paper demonstrates how non-market valuation methods can be adapted to quantifying the distribution of environmental benefits and costs on minority groups and low income households to meet the requirements of Executive Order 12898 on Environmental Justice. The hedonic property method can test for significant differences in the absolute and relative effect on residential property values from degrading or improving environmental quality on minorities and low income households. The contingent valuation method can monetize the absolute and relative change in use and passive use values to minority and low income households. The ability of the
contingent valuation method to make an income assessment was illustrated for urban instream flows in Colorado. Also using the contingent valuation method the distribution of benefits from wildfire fuel reduction programs to Hispanics in California and Florida were quite different than for White households. However, there was less difference between White households and Native Americans in Montana for the same fuel reduction programs.

The distributions of monetary benefits can be compared to the distribution of the tax burden necessary to finance these programs to arrive at the distribution of net benefits (i.e., benefits minus costs) of these programs. This type of information should improve the completeness of Environmental Justice analysis and complement the existing qualitative and descriptive analyses in Environmental Impact Statements, agency plans and agency regulatory analyses.

References


