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Factors Affecting Consumer Assessment of Eco-Labeled Traditional Fuel Passenger Vehicles

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FACTORS AFFECTING CONSUMER ASSESSMENT OF ECO-LABELED TRADITIONAL FUEL PASSENGER VEHICLES

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An Abstract of the Thesis Presented
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Acknowledging and understanding the role that information may play in affecting consumer assessment of eco-marketed products is a key step in improving the effectiveness of eco-labeling initiatives. Consumers who hold preferences for environmentally preferred products may be unable to express their preferences for such goods under current eco-information campaigns. The emerging use of eco-labels suggests they may be an effective means of communicating the environmental attributes of a product to consumers, and thus provide an opportunity for consumers to alter their consumption behaviors.

This analysis employed a state-wide sample of Maine registered vehicle owners in a survey effort aimed at determining the factors which affect their assessments of eco-labeled traditional-fueled passenger vehicles. The study focuses on two specific areas. The first develops an appropriate empirical framework with which to model the vehicle choice decision under eco-labeled conditions. We specifically examine how eco-information may affect the two-stage vehicle purchase process. Additionally the study

focuses on whether consumers react to information regarding specific pollutants homogenously or heterogeneously based on the personal characteristics of the consumer. The study builds upon environmental economic and psychology literature in examining the role of personal characteristics such as perceived effectiveness of consumer purchase decisions and perceptions of the eco-labeled products as factors in the vehicle purchase decision.

It was found that environmental attributes of an eco-labeled passenger vehicle are significant in the purchase decision. The eco-information is considered in the vehicle purchase decision, but is generally not considered at the class level decision. These results have policy ramifications for current eco-labeling initiatives that do not consider the two-stage nature of the vehicle purchase decision. Of additional importance, consumers reacted differently to the two primary pollutants contained on the emission profiles of the vehicles, indicating that future eco-labeling initiatives should provide specific emissions information for eco-labeled vehicles. Personal perceptions are significant in the purchase decision, which suggests an avenue of enhancing the effectiveness of eco-labeling initiatives through educational campaigns to alter incorrect pre-conceived perceptions.

The analysis provides important information for policy makers. First, policy makers should recognize the two-stage nature of the vehicle purchase decision and adjust current eco-labeling programs accordingly. The results also suggest that the differing consumer response to the various pollutants indicate that future eco-labeling initiatives should reveal specific information about the environmental attributes of the vehicles in order to achieve maximum effectiveness. Finally, the examination of the relationship

between consumer perceptions and environmentally preferred purchase behavior suggest that eco-labeling initiatives accompanied by educational campaigns may meet with greater success that eco-labels alone. Consumers with differing perception profiles do react to environmental attribute information differently, and it is important that consumers be provided with the correct information throughout an eco-marketing initiative.

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INTRODUCTION

The health and welfare of the environment has become an increasingly important public issue for consumers' nation and worldwide. The Northeast States for Coordinated Air Use Management (NESCAUM) reports that survey participants ranked air pollution in the top nine public issues that Americans are most concerned about (2003). As environmental welfare becomes a priority issue, consumer polling indicates that consumers are willing to pay more for environmentally sound products leading manufacturers and suppliers to respond by introducing environmentally preferred products into the market (Kirchhoff, 2000). This increased interest in environmentally preferred products has led policy makers, consumers and suppliers to consider the use of eco-labels as a means of improving consumer welfare by improving the information available to consumers during the decision making process, and thus enhancing the available choice set (Teisl et. al, 2003).

The use of eco-labels is well established in natural resource consumption literature, however this approach is far less familiar as a means of pollution control (Tietenberg, 1998). The idea of using eco-labels, as a means of controlling air pollution from motor vehicles is not a novel one, but warrants further consideration as proposed by this research. Is Tietenberg correct in his analysis that the third phase of pollution control is the dissemination of information? Will eco-labels enable consumers to identify environmentally preferred passenger vehicles and introduce emissions profiles as a principal

component in the purchase decision? Most importantly, will this identification process actually yield a change in consumer behavior (i.e. increase purchases of eco-labeled passenger vehicles)?

There are several elements that should be considered as eco-labeling initiatives are implemented as pollution control mechanisms. First, we must consider those factors that may limit the benefits associated with eco-labeling. In order for eco-labeling initiatives to meet with success, not only must consumers hold preferences for environmentally preferred products, they also must be able to comprehend the information being presented and be willing to pay a premium for these products. Additionally, eco-labels must be perceived as containing credible information. Given that most consumers will be unable to personally verify the emissions profile of a passenger vehicle, they must be satisfied with the level of, and credibility of, information presented on an eco-label in order to incorporate environmental attributes into their purchase decisions. This implies that a group or agency that consumers deem to be an appropriate judge of a products environmental status must proffer the environmental information. Many studies have investigated the credibility of various agencies and organizations in providing information to consumers (e.g. see Vlosky and Ozanne, 1998; Teisl et. al 2000, 2004; Teisl, O'Brien and Peavey, 2001). The current analysis informed participants that the custodian of vehicle emissions profiles is the Maine Department of Environmental Protection (DEP). This is a logical choice as the DEP is responsible for environmental quality in the state of Maine.

Second, it should be recognized that various types of eco-labeling schemes exist that provide different levels of information, where an effective program must facilitate the best possible match between the preferences of consumers and available products. This is generally best accomplished through dissemination of information in varying amounts. Currently, there are two distinct systems of eco-labeling. A Type I label or 'eco-seal' provides limited information about the actual environmental attributes of a good (Roe et. al, 2001). This label indicates rather or not a product has met a pre-specified set of conditions. One limitation of this system is that typically the set of conditions are not included on the actual label. Thus such programs operate under an assumed level of consumer familiarity with the underlying standards denoted by the label. In contrast, a Type III label provides detailed information about the environmental attributes of a product, much like a nutrition label indicates all the components of a food product (Roe et. al, 2001). Consumers are not necessarily assumed to have prior experience with these labels. Previous research into the effectiveness of these two labeling systems have found that Type I labels may be less effective in comparison to the more detailed Type III labels (Teisl and Roe, 2000). To maintain consistency with these findings, the current analysis employs detailed modified Type III eco-labels containing emissions profiles of individual passenger vehicles. The inclusion of detailed environmental attribute information allows for further identification and analysis of those factors that may influence consumer assessment of eco-labeled passenger vehicles. By identifying crucial factors, subsequent policies promoting eco-labels can be more effective in

connecting with consumers. Additionally, the presentation of explicit emissions profiles allows this study to investigate differing responses to specific air pollutants, which may affect future policy initiatives.

The third element that should be considered in constructing effective eco-labeling programs is the role that pre-conceived consumer perceptions and knowledge play in assessment of eco-labels. Eco-labels may serve as a means of reinforcing or supplementing current knowledge held by consumers. In a 1999 survey by the Institute for Cancer Research, 64% of respondents indicated that they believe passenger vehicles are the greatest source of air pollution. However, this prior knowledge does not necessarily translate to comprehension regarding the link between fuel economy and greenhouse gas emissions herein referred to as global warming gases) (DeCicco, 2003). Of additional concern is that consumers with varying pre-conceived perceptions and knowledge might respond differently to the information presented on eco-labels.

Previous research also indicates that consumer preferences for environmentally preferred products might need to be 'active' in order to affect the purchase decision. Tietenberg (1998) in a review of a radon information program finds that information disclosure is more effective if it takes place when a transaction is occurring. This lends support to the use of eco-labeling as a means to 'activate' consumer perceptions and preferences, as eco-labels provide information at the time of purchase.

Finally, in order for eco-labeling initiatives to meet with the greatest level of success, the marketing of the labels should be targeted to the most receptive

audience. Previous research into socio-economic characteristics and a consumers subsequent environmental concern have yielded widely varying results. This analysis expands upon current research, which generally considers the demographic variables of age, gender and education as significant factors in the purchase decision. The role of concern for environmental resources, and a consumer's view of eco-labeled vehicles as an appropriate substitute for current vehicles will be considered in this analysis as possible influencing factors. Additionally, environmental concern has traditionally been measured by a variety of variables within a survey instrument and not separated into individual constructs. However, as suggested by Ellen et. al (1991) this analysis will examine the separate role that perceived consumer effectiveness (PCE) and faith in others (FIO) may play in a consumers purchase decision. This study contends that explicit emissions profile information (i.e. Type III labels), individual perceptions and environmental concern will play an important role in determining the likelihood of purchasing an eco-labeled vehicle. The following analysis investigates this hypothesis.

This study deviates from previous studies in its focus on traditional fueled vehicles, and inclusion of personal perceptions as explanatory variables in the environmentally conscious purchase decision. The objectives of this analysis are two fold. The first objective of this analysis is to determine the factors that influence the vehicle purchase decision, by developing an appropriate empirical model. The second objective is to examine the personal characteristics that may affect consumer assessment and purchase of eco-labeled.

Chapter 2

REVIEW OF LITERATURE

The current analysis considered previous studies from a variety of subjects and disciplines. The review of these materials will be divided into sections considering what types of market deficiencies may necessitate the use of eco-labels in a market, the role that eco-labels may play in the passenger vehicle market as well as some of the limitations of eco-labels. Additionally previous work regarding the link between environmental attitudes, perceptions and subsequent behavior will be reviewed, as well as previous efforts to identify "the environmentally concerned consumer".

Market Deficiencies and Eco-Labels

Economic theory indicates that the free flow of information plays an essential part in ensuring that markets reach efficiency (Teisl and Roe, 1998). Economic theory also suggests that if search costs are high this may prevent markets from reaching equilibrium. It is the breakdown of these two market components that has brought about an increasing role for eco-labeling programs; such programs can be seen as possible corrections to two distinct market deficiencies: asymmetric information and high search costs (Teisl and Roe, 1998).

In addressing the first deficiency of asymmetric information, economists have strived to identify the information that consumers would like, but are unable to obtain with respect to environmentally preferred products. A study by Kirchoff (2000) indicates that consumers want to purchase environmentally friendly goods

but are unable to identify them with the current flow of information. Teisl, Peavey and O'Brien (2001) indicate that eco-labels are precisely the means of facilitating a direct match between consumers who would like to buy environmental preferred goods and such goods.

The second difficulty, high search cost, can also be addressed by eco-labels. Consumers tend to consider three categories of product attributes during a purchase decision: search, experience and credence. In accordance with the definitions of product attributes used by Teisl and Roe (1998), search attributes can be assessed prior to purchasing a good while experience attributes can be assessed only after purchasing and using the product. However, credence attributes, such as environmental assets, cannot be assessed even after purchase. It is thus very costly for consumers to gain any information on credence attributes. As consumers are not equally able to finance searches for product information the free flow of market information is interrupted (Capon and Lutz, 1983). Eco-labels are seen as an increasingly important means of decreasing search costs, especially for credence attributes (Teisl and Roe, 1998).

Eco-Labels and the Passenger Vehicle Market

As noted above, economic theory thus suggests that eco-labels may be a means of correcting market deficiencies in product markets. However, the need for eco-labels in the passenger vehicle market has yet to be established. A majority of the previous eco-choice literature has focused on the sale of smaller, non-durable items. This gap in the existing literature leaves the current study with little guidance on the suitability of eco-labels in the vehicle market. Thus, one

must consider the types of issues faced during labeling efforts in other market sectors in order to determine rather eco-labels would be appropriate in this market.

We should first turn our attention to the question of why eco-labels are needed in the passenger vehicle market. A new type of market failure not previously discussed exists in the vehicle market: an externality. Passenger vehicle use creates pollution and imposes health and environmental hazards on the public (DeCicco 2003). Such an externality, in accordance with economic theory, is a market failure and as such creates a role for government intervention. A motivating point for use of eco-labels in the passenger vehicle market is the current difficulty that traditional policy initiatives (i.e. command and control approaches) have had in reaching policy goals regarding the aforementioned externalities, such as reduced fossil fuel use and lower air emissions. Eco-labeling is generally less expensive and less intrusive than traditional policy regulations and thus may be an alternative means of moving this market towards a socially optimal level (Teisl and Roe, 1998).

One difficulty facing the proposed eco-labeling of personal vehicles is that currently consumers may not consider the environment during their car buying behavior, and thus additional environmental information provided by eco-labels may not be utilized (DeCicco, 2003). Although the literature suggests that consumers are generally unaware of the environmental consequences of their vehicles, the presence of information has been shown to affect the value a consumer places on environmental qualities (DeCicco, 2003; Teisl, Roe and

Hicks, 2002). Thus a Cost of Ignorance (COI) may exist in this market where there is information that could change consumers' welfare without changing the actual quality of the good (Teisl and Roe, 1998). If consumers do not have the level of knowledge needed to utilize eco-labels, this suggests that eco-labels in the passenger vehicle market must include not only environmental information, but also an educational aspect that links current consumer knowledge (i.e. miles per gallon) to environmental externalities (i.e. greenhouse gases). As argued by Grankvist (2003) a prerequisite for using an eco-label is awareness of the label's existence and comprehension of the label's meaning.

Next we ought to consider the empirical evidence that eco-labels have influenced other product markets by correcting the market inefficiencies noted above. A study by Teisl, Roe and Hicks (2002) provides market-based evidence that eco-labels had a significant impact on consumer purchases in the tuna market. Similar market-based studies have been conducted by Levy et. al. (1985) and Teisl and Roe (1998). Levy's work indicates that changing information on nutrition labels influences consumer behavior while Teisl and Roe's work provides market based evidence that suggests labels allow consumers to substitute across products (i.e. substitute eco-labeled products for non-labeled products). Previous work also indicates that labels which provide more detail are viewed as more credible by consumers (Teisl, Peavey and O'Brien, 2001). Eco-label studies to date have noted that labels which are compulsory, explicit and in standard format best "facilitates consumer choice" (Teisl and Roe, 1998; Roe et. al, 2001).

Although there have been numerous studies (Brownstone et. al. 1996a, b, Bunch et. al. 1996 and Golob & Gould 1998), indicating a demand for 'greener'[1] vehicles, few of these vehicles have actually penetrated the market (Rubin and Leiby, 2000). One possible reason that few of these 'green' vehicles have penetrated the market is consumers are generally wary of unproven goods and tend to trust the reputation of seller's they have previously purchased from (Cason and Gangadharan, 2000). This suggests that consumers may trust makes and models of vehicles they already know over unproven models of 'green' vehicles. Thus eco-labeling of known traditional fuel vehicles may affect a larger market segment than labeling purely 'green' vehicles, which rely on alternate fuel sources.

Limitations of Eco-Labels and Calls for Future Research

Eco-labels, like all policy tools, have limitations that necessitate further investigation. Perhaps the most challenging aspect of eco-label research is the notable time lag between introduction of the label and influence on consumer behavior (Teisl and Roe, 1998). Any eco-label policy implemented will require time for consumers to adjust to the label before any evaluation of the policy can take place. Another difficulty is the problem of non-standardized labels. Labels are introduced as a means of cutting search costs, however labels which make attributes hard to discern may actually increase the cost of information to consumers. Eco-labeling initiatives must recall that consumers are constrained by budget, time and cognitive abilities during their purchase decisions (Teisl and

[1] In this context, green vehicles refer to alternative fuel (i.e. electric, etc) or hybrid vehicles that were not included in the scope of this current studies.

Roe, 1998). Of additional concern is the possibility of free-riding, which is consumer A assuming that consumer B will purchase the environmental good while A enjoys all the benefits of improved environmental quality. This possibility is of particular concern because labels alone may not help move the market to a socially optimal level (Teisl and Roe, 1998). The gravest concern facing eco-labeling programs is the fact that changing awareness by consumers may not translate into an actual change in behavior (Teisl, Roe and Hicks, 2002). As the ultimate policy goal of labels is to educate consumers about environmental impacts and lead to a change in behavior where consumers purchase greater numbers of environmentally preferred products, this possibility might negate the benefits of eco-labels. Further consideration of environmental concern and its impact on behavior will be undertaken in this analysis.

Given the possible benefits and limitations of eco-labels, particularly with regard to the passenger vehicle market the question remains, what steps should be taken next in the field of eco-label research? Teisl and Roe (1998) call for further research into the conditions needed for effective labeling policy, including what characteristics of labels, consumers and products that are needed for a successful program. DeCicco (2003) calls for "developing appropriate ways to evaluate the impact of improved environmental information for automotive consumers" (pg. 5). The study contained within this thesis looks to address this challenge.

The Link Between Attitude, Perceptions and Behavior

Economic theory suggests that demand for a good is a function of a number of factors. Thus a consumer making a purchase decision may be

influenced by a number of factors, many of which are outlined by traditional demand theory such as own price, price of substitutes, etc. However economics has come to recognize that characteristics of an individual may also influence their purchase decisions. As this study is particularly interested in how consumers would react to eco-labeled vehicles, we must investigate how ones personal characteristics may interact with eco-labels to influence consumer behavior.

The current eco-choice literature suggests two possible roles that personal views may take in the purchase decision. One school of thought indicates that a person's general view of the environment will be a significant factor in the purchase decision surrounding eco-labeled products. A second series of literature suggest that only concerns specific to the actual environmental issue related to the product under consideration will affect purchases. However, in reconciling these two camps it has been suggested that general environmental factors are influential during early stages of the decision process, while specific views regarding eco-labeled products may be influential at later stages of the decision process (Grankvist, 2003). Thus the possible influence of both general and specific factors will be discussed herein.

In considering personal characteristics that may influence consumer behavior, Thogersen (1999) suggests that individuals establish their own personal norms. He indicates that awareness of environmental problems and the belief that one can impact these problems are crucial factors in developing a personal norm. His results indicate that a strong personal norm regarding the environment has a

high correlation to environmentally conscious behavior. Additionally, he found that stronger personal norms increased the amount of attention that a consumer gave to the environmental aspects of a good (Thogersen 1999). Thus his work indicates that a consumer's attention to eco-labels is influenced by the belief that purchasing environmentally conscious products are part of the solution to environmental problems (Thogersen 2000a,b). This perceived consumer effectiveness (PCE) is the belief that one consumer, through their purchase choices, is an important part of the solution to environmental problems (Ellen et. al., 1991). This construct is also frequently referred to as 'Ascription of Responsibility to Self' (AR) by researchers in the field of environmental psychology (Stern, 2000). The inclusion of PCE (or AR) as a separate construct in explaining behavior is indicated by Ellen, et. al. in their 1991 work. Previous work reviewed by the 1991 study found that PCE had been traditionally included as part of general environmental concern variables and thus PCE's role in predicting behavior may have been understated (Ellen et. al.,1991). These studies suggest that a consumer's PCE warrants further investigation. Additionally, they hypothesize and provide empirical evidence that a lower PCE leads to decreased willingness to purchase environmentally friendly products. These findings are consistent with work by Balderjahn (1988) indicating that a high PCE does indeed lead to an increase in environmentally friendly behavior.

The work introduced above is further supported by a study performed by Aceti Associates (2002). Their results indicate that one of the prime motivating factors for purchasing green products was high perceived consumer effectiveness.

Further, work by Lee and Holden (1999) indicates that PCE was a significant and positive predictor of high-cost environmental behavior (i.e. where a consumer had to make a substantial compromise in order to purchase the greener alternative). The above-cited materials imply that the role of PCE as a factor affecting consumer purchase behavior with respect to eco-labeled products warrants further investigation, as undertaken by this study.

Another component of environmental concern that has traditionally been incorporated within general environmental attitude variables has recently been recognized as a separate construct as well: faith in others (FIO). Thogersen (1999) refers to the idea of a social norm, where consumers perceive that certain behaviors are acceptable and desired in society. Bamberg (2003) points to Ajzens's theory of planned behavior where normative expectations of others may be a factor in an individual's behavior. Work by Gould and Golob (1998) indicates that the behaviors of others did influence the participants in their study; drivers often felt no personal responsibility for vehicle air pollution because they noted worse offenders. Literature from the field of environmental psychology also refers to the effects that 'Awareness of Adverse Consequence' (AC) may have in the purchase decisions. Results suggest that information, such as that provided on an eco-label, may be able to activate consumer's environmental norms by highlighting consequences or benefits to self and others (Stern, 2000). The current analysis intends to further investigate the role that perceived social norms (aka FIO or AC) might play in a consumer's environmental behavior, including the decision to purchase an eco-labeled vehicle.

In his 1999 work Thogersen expands upon the hypothesis that a consumer's personal characteristics may influence consumer behavior. Thogersen suggests that a consumer would be more likely to make an environmentally responsible consumption choice if they hold personal concern for the environment. He specifically felt that consumers would need to have a high level of concern for the environmental issue that was directly tied to the consumer product they were about to buy (Thogersen 1999). For example, consumers considering the purchase of tuna, who had a high level of concern for dolphins, would be more likely to choose the dolphin-safe labeled tuna, in relation to a consumer who had no personal feelings towards dolphins. Stern, in his 2000 work, identified three types of environmentally significant behavior, amongst which was consumer purchase behavior (entitled private sphere environmentalism). He found that private sphere environmentalism is primarily influence by personal capabilities (ex: financial resources) and behavior specific knowledge, not general attitudinal factors.

Thogersen's and Stern's works are particularly applicable to this study. As air pollution is the primary environmental consequence associated with passenger vehicles, one can begin to imagine that a high level of concern regarding air pollution may influence a consumer's choice of vehicle. This possibility is further strengthened by the work of Henry and Gordon (2003) in studying the affect of a public information campaign on driving behavior. Henry and Gordon (2003) recognize in their work that awareness of the link between driving and poor air quality was needed in order to "influence target behaviors",

in this case driving. Additional work by Hini et. al. (1995) found empirical evidence that attitudes specifically related to the behavior at hand accounted for most of the explained variance in their results. Their findings indicate that attitudes have a better predictive ability for behavior than demographics alone, but only a weak relationship was shown to exist between general attitudes and follow up behavior (Hini, et. al., 1995). The collection of these works motivates the use of variables that attempt to capture a consumer's specific attitude toward the environmental quality under consideration, which in this study is air quality, in conjunction with traditional demographic variables.

While the above-mentioned constructs of personal norms, PCE, FIO and issue specific attitudes, are believed to significantly influence ones environmental behavior, there are barriers to environmentally friendly consumption that must also be taken into consideration. The previously mentioned study by Aceti Associations (2002) found that respondents perceived green goods to be products of inferior quality, and that this perception was the top barrier to environmental purchasing. Previous studies have also noted that pro-environmental behavior depends on the context of the purchase, where inconvenience associated with buying green is a prohibiting factor for green consumerism (Stern, 1999). Importantly, Thogersen (2000b) notes that consumers do not buy goods for the sole purpose of protecting the environment. Consumers purchase goods for the perceived utility they will obtain; however consumers may try to diminish the impact of their consumption by choosing environmentally friendly goods (Thogersen 2000b). Clearly if consumers purchase goods for their utility,

consumers will be unwilling to substitute a good they perceive as providing lower utility merely because it is eco-labeled. In the current study consumer's purchase vehicles because they require the vehicle to perform a specific set of functions that may not be met by all vehicle types (e.g. one cannot haul a boat behind a compact car). Consumers may be unwilling to purchase eco-labeled vehicles if such vehicles do not meet pre-set requirements.

Additionally consumers must evaluate the risk they may be taking by buying an eco-labeled item that they are unfamiliar with (Thogersen 2000a). As vehicles are such a large ticket item, the risk associated with an incorrect decision is clearly higher for consumers in the vehicle market. Thogersen (2000a) indicates that eco-labeled products become a tougher sell when a large compromise is required to purchase the green product. However, given the perception that green products may be inferior, while the compromise may not actually be large to buy green, the *perceived* compromise is large. In addition, previous studies have also indicated that if other characteristics of a good monopolize a consumer's attention, the role of environmental concern in the decision will be lessened (Thogersen 1999). One can imagine that *perceived* inferiority may monopolize a consumer's attention and thus decrease the likelihood of buying green. Thus it is clear from the works reviewed above that it is important to determine how strong a role perception of eco-labeled goods may play in consumers decision to buy green.

Identifying the Environmentally Concerned Consumer

Extensive research has been conducted in an effort to identify the demographic profile of the environmentally concerned consumer. Unfortunately this collection of work has found no basic profile of such a green consumer, instead finding highly variable results. In the work of Balderjahn (1998) the results indicate that upper class households exhibit more eco-friendly behavior. This work also indicates that increased education increased the likelihood of participating in environmentally friendly behavior. Zelezny et. al. (2000) in their review of studies performed between 1988 and 1998 on environmental behavior, state that women on average report stronger environmental behavior than men. They indicate that future models of environmental behavior should include gender as a relevant predictor of environmentalism. Work by Mainieri, et. al. (1997) also attempted to investigate how demographic variables may affect eco-consumerism. Their findings are consistent with those of Zelezny et. al. with respect to gender, as they also report that women on average scored higher than men on pro-environmental measures utilized in their work. They note that traditionally young, well-educated, affluent urban dwellers were considered to be the environmentally concerned public (Mainieri et. al 1997). However, their results indicate that the demographic variables of age, income and education did not have a significant relationship with the dependant variable of environmental concern. Moreover, work by Byrnes et. al. (1999) provides evidence that levels of education do have a positive effect on willingness to pay for increased environmental quality. Finally, work by Stern in 2000 suggests that participation

in an environmental group may also influence environmental behavior of a consumer. In agreement with the disjointed nature of these findings Balderjahn concludes that "no general picture of the ecologically concerned consumer" was found during his study (1998). The above-cited materials suggest that there is further need for exploration into how demographic variables might affect consumers' environmentally conscious consumption decisions.

The current study, drawing on the previous works reviewed above, intends to analyze how consumer choice regarding eco-labeled vehicles differs with respect to: a) concern for, and salience of, the environmental issue at hand [Maine's air quality], b) personal and social norms including perceived consumer effectiveness (PCE) and faith in others (FIO), c) perceptions of eco-labeled goods as adequate substitutes and d) socio-economic and demographic characteristics of the consumer.

Chapter 3

THEORETICAL FRAMEWORK

In order to begin understanding what factors might affect a consumer's assessment of eco-labeled passenger vehicles, one must first ascertain how the environmental quality of a product enters a consumer's utility function and decision-making process. In order to evaluate changes in utility, an indirect utility function is employed:

$$(1) \qquad V = v(\mathbf{A}, \mathbf{P}, Y, \mathbf{C}, \mathbf{Q})$$

where **A** is a vector of environmental (credence)[2] attributes, **P** is a vector of prices and Y indicates income. **C** represents a vector of a consumer's personal characteristics, including gender, age and stock of prior knowledge regarding the environment. **Q** denotes a vector search or experiential characteristics of the product.

The incorporation of additional information can be viewed as a household production function, where a consumer incorporates their own production assets, such as prior environmental knowledge or skills along with the time to "produce" or make a decision, given the information available. This assessment process can be modeled as:

$$(2) \qquad A_{kj}^{s} = f(S_{kj}, \mathbf{C}, t)$$

where A_{kj}^{s} denotes the consumer's assessment of the environmental impact of purchasing a good kj given the information set S_{kj}. The variable S_{kj} is the environmental information being displayed [i.e. the eco-label] at the time of

[2] Search attributes can be assessed prior to purchasing a good; Experience attributes can be assessed only after using the product; Credence attributes cannot be easily assessed by the consumer even after purchase or use.

purchase. **C** continues to represent a vector of a consumer's individual characteristics, which includes stock of prior environmental knowledge and t designates the amount of time required to process the label and produce a decision.

The modeling of additional information into a household production function has previously been examined in the literature (Teisl, Roe & Hicks, 2002; Teisl & Roe, 1998). The use of this function assumes that consumers are rational agents who make choices that incorporate all relevant details of the present situation. The theory of bounded rationality, introduced by Simon (1957) and more recently discussed by Kahneman (2003), indicates that an individual's overall capacity for mental effort is limited. This theory posits the concept of 'narrow-framing' where consumer decision-making occurs in two distinct systems. The first system is governed by habit and automatic responses, however the second system of skill acquisition and deliberate contemplation more closely corresponds to the choice process posited here (i.e. household production function).

Given that vehicle choice depends upon the expected utility of class choice (j) and the expected level of utility from individual vehicle choice (k), the appropriate form for the indirect utility must be carefully considered. In conforming to work by Greene (2001) the individual's utility for vehicle choice, k, in class set, j, is given by:

$$(3) \qquad V_{kj} = v\left(A_{kj}^{S}, \mathbf{P}_{kj}, Y, \mathbf{C}, \mathbf{Q}_{j}\right)$$

The unobservable environmental attributes **A** will be assessed given the information set S_{jk}. The observable attributes, **Q**, will also be considered across class, as they are often factors that distinguish the various vehicle classes. However, these attributes may not be considered during vehicle choice as vehicles within a class share a set of attributes. The price, **P**, and income, **Y**, will no doubt contribute to the indirect utility function. Finally, the consumer characteristics, **C**, are included in the indirect utility as differing personal characteristics may affect vehicle choice decisions. This analysis can now turn to utility maximizing choices.

A consumer choosing good X_a over good X_b will make such a choice if it results in greater utility. This choice can be modeled as:

(4) $$V_a\,(A^s\,(*),\, q_a,\, Y,\, P_a,\, C) + e_a > V_b\,(A^s\,(*)\,,\, q_b,\, Y,\, P_b,\, C) + e_b$$

where $(a \neq b)$, and e represents the unobservable components of an individual's utility function. Thus the objective becomes identifying the values that would maximize the probability of choosing X_a, where the probability of choosing X_a is equal to the probability that the utility associated with X_a is greater than the utility of X_b such that:

(5) $$Pr(X_a)=Pr[v\,(A^s{}_a\,(*),q_a,\, Y,\, P_a) + e_a\,] > Pr[v\,(A^s{}_b(*),\, q_b, Y,\, P_b)] + e_b\,]$$

Chapter 4

METHODS

The empirical analysis is primarily based upon a nineteen-page survey that was implemented in order to gather baseline data on the willingness of Maine citizens to purchase environmentally friendly passenger vehicles. The survey was also employed to gage the reactions of Maine citizens to various eco-labels under review by the Maine Department of Environmental Protection. This chapter serves as clarification of the methods employed in creating and implementing the survey instrument.

Survey Sampling

In May of 2004, 1,382,735 records were obtained from the Maine Bureau of Motor Vehicles through InforME, the state government's data provider. The records represented all citizens who had registered a vehicle in Maine within the past year. Thus, the records obtained represented almost every vehicle owner in the state of Maine. It should be noted that Maine citizens who did not register a vehicle in 2003-2004 would not be included in this sample. As the target population for the survey was vehicle owners and buyers in Maine, this sample framework should provide an adequate sample.

To obtain a representative sample from these records, a random sample of 2,000 was generated. In recognition that many of the records would prove unsuitable for the intended survey, approximately 800 records were removed from the initial sample of 2000. Records were rejected if the primary address listed was outside the State of Maine, or if the vehicle make was listed as homemade.

Additionally, records associated with registration of utility trailers, snowmobiles, boats or other non-passenger vehicles were excluded. The records were also checked for multiple registrations. Additionally, records that included vehicles older than 1985 were removed, as these individuals were assumed to be not in the new car market. Of the 2000 records in the initial sample, only 9% (180 records) were removed due to model year of the vehicle. However, of the 180 records removed due to model year, 46% of these vehicles had model years between 1980 and 1985. This may have inadvertently eliminated a lower-income segment from the sample, those who could not afford newer vehicles. Given that the average lifespan of a new vehicle averages eleven years, future research may consider eliminating only those records with model year prior to 1980 in order to avoid this problem. Finally, records that did not have a valid vehicle identification number were removed from the sample. The remaining 1,200 records received a United States Postal Service address certification check, where fifty-two (52) faulty addresses were removed from the sample. Thus, a final sample of 1,148 Maine citizens received the initial letter that introduced the survey to participants. However, eighty-seven (87) introductory letters were returned as undeliverable.

The survey was administered in a three-round modified Dillman method between June and August of 2004. Each round after the initial introduction letter presented the participant with a copy of the survey, a reminder letter and a one-dollar cash incentive. The total number of respondents was 620, with 107 undeliverable and 14 surveys returned refused, for a response rate of 60 percent [620/(1148-107)]. Additionally, in the final (3^{rd}) round of reminders,

approximately one-half of the mailing received a test treatment designed to increase response rate. The treatment involved the writing of "Gift and Survey Enclosed. Please Respond" on the front of the outer envelope. The results of this treatment will not be included in the analysis contained within this thesis.

The survey's respondents are somewhat older, wealthier and more male than Maine's adult population, as shown in Table 1. It should be noted that inconsistencies that may exist between the two groups, could be partially attributed to the fact that the survey sample consists only of vehicle owners and not the general adult population. With respect to age, the survey respondents were generally older than the average Maine adult. The survey respondents were typically better educated than the Maine average, and had higher reported median household income. The higher reported income could be attributed, as discussed earlier, to the elimination of records with pre-1985 model years. One would expect that older vehicle owners generally have a lower income. The respondents also represented a higher percentage of males than the average percent of males in Maine. Approximately 60 percent of Maine registered vehicle owners, according to our sample frame, were male. Thus our sample, where 61.6 percent of respondents were male was very representative of the sample frame. The sample statistics reveal that survey respondents race percentiles closely match those reported for Maine adults. Given the above information the sample appears to fairly represent Maine vehicle owners, the target population.

Care was also taken to ensure that the survey administration mirrored the population distribution of Maine as this is widely varied throughout the state.

Frequency checks were conducted between the initial survey sample of 2,000 and Maine population data from 2000. The outcome of these frequency checks indicated that the sample accurately reflected the population distribution of Maine. An example of this frequency check is included in Table 2.

Table 1. Socio-Economic Characteristics of Survey Respondents and Maine Adults.[a]

	Survey Respondents	Maine Adults
Gender (percent female)	38.3%	51.3%
Average Age	50.8	38.6
Race (percent white)	98.3%	96.9%
Average Education (in years)	14	13
Average Household Income	$51,794	$37,240

[a] Data obtained from the U.S. Census Bureau [http://quickfacts.census.gov/qfd/states/23000.html]

Table 2. Example of Frequency Check of Sample

Town Name	2000 Population Percentage	Sample Percentage
Auburn	1.819	1.65
Veazie	0.136	0.10
Winter Harbor	0.07	0.05
Sebec	0.048	0.05
West Gardiner	0.227	0.25

Survey Design

The survey instrument was primarily based upon the results of focus groups held with Maine citizens in the fall of 2004, and upon input from the Environmental Protection Agency (EPA), Maine Department of Environmental Protection (DEP), the Maine Auto Dealers Association and the Natural Resources Council of Maine (Teisl, Rubin, et. al 2004). Participants in the six (6) focus groups were recruited from three regions in Maine; the Portland, Lewiston-Auburn and Bangor areas,

where two focus groups occurred in each area. All participants were current vehicle owners of varying demographic characteristics. The focus groups concentrated on two main segments; segment one focused on factors that affected the vehicle purchasing decision and segment two allowed participants to view and respond to a variety of possible eco-labels and eco-marketing initiatives. Segment one included discussion of the importance of gas mileage to a consumer, what attributes differentiate similar vehicles, and environmental considerations surrounding motor vehicles, including Maine's air quality. Participants were then able to view alternate eco-labels and indicate who should certify the labels, what information should be included on any label, and express opinions regarding label format.

The survey instrument consisted of seven sections with a total of forty-one questions (see Appendix A which contains a complete copy of the survey). Section I solicited respondents opinions on air quality in Maine, and the relationship between passenger vehicles and air pollution. In Section II respondents were asked to express their views on environmental protection. Questions in this section attempted to ascertain a respondent's perceived consumer effectiveness, faith in others, perceptions of eco-label vehicle as possible substitutes and general level of environmental concern. Work by Thogersen (2000) indicates that eco-labels are more likely to be effective when consumers jointly perceive that there is an environmental problem and that their own, as well as others, eco-label induced buying behavior can make a difference in alleviating the problem. The latter of these two perceptions, Thogersen refers

to as a social norm, where consumers perceive that certain behaviors are acceptable and desired in society (Thogersen 1999). The current analysis intends to further investigate the role that perceived social norms, perceived consumer effectiveness and personal level of environmental concern might play in a consumer's environmental behavior (i.e. including the decision to purchase an eco-labeled vehicle).

Section III discerned a respondent's current vehicle information, including the type of vehicle and the importance of various attributes considered during the purchase decision. In Section IV respondents provided insight into their search and use of environmental information in the vehicle purchase decision.

Section V introduced vehicle eco-labels to respondents. All respondents viewed the current State of Maine Clean Car label (Figure 1), and were asked to identify other pieces of information that could be included on this label. Respondents were then presented with an eco-label with differing formats and information levels. Five different versions of the survey were created and distributed evenly throughout the sample (Table 3). This includes the base case where only the State of Maine Clean Car label was presented with no additional text or information, as in Figure 1 (see Appendix B). Respondents were then asked to rate the label they viewed on credibility, perceived environmental friendliness of the vehicle, satisfaction with the level of information provided (and importance of information to the individual) along with likelihood of purchase. The differing versions of the eco-labels were a necessary component of the survey as each label presented represents distinct forms of labeling.

Figure 1. Maine Clean Car Label

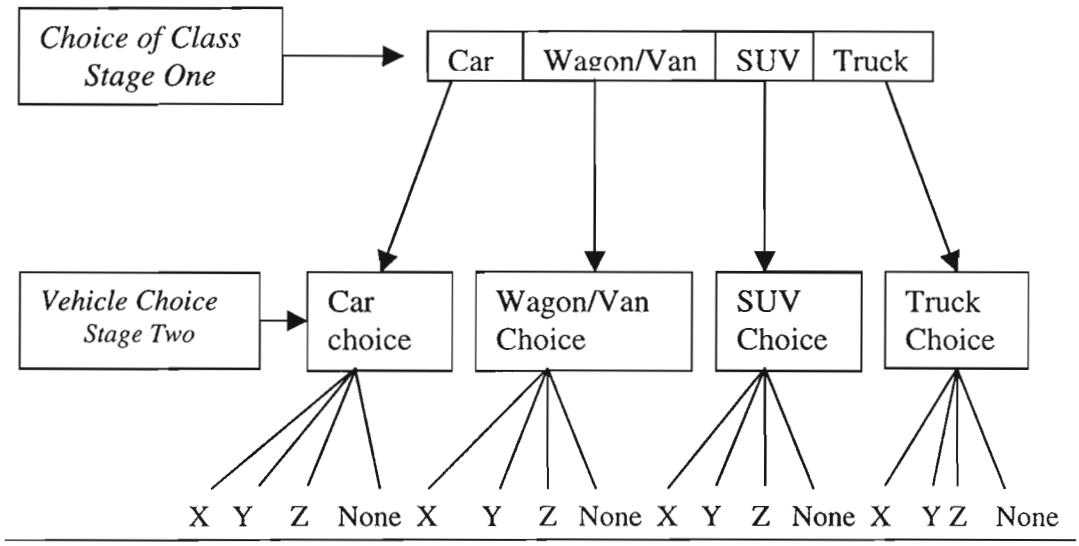
Table 3. Survey Variations

Variation Type	Percent of Surveys Displaying
Version A: Base Case	17.3%
Version B: Sliding Scale comparison to average of all vehicles in class	17.3%
Version C: Sliding Scale comparison to average for all personal vehicles	17.3%
Version D: Thermometer scale comparing to average of all personal vehicles	17.3%
Version E: Sliding Scale comparison to all other personal vehicles and vehicles in class.	30.2%
Information Treatment	50.2%

The base case label is an example of a Type I label, or eco-seal, indicating that the vehicle met a pre-specified set of standards, but provides no additional information (Roe, Teisl, Rong and Leavey 2001). In this instance, the seal denotes vehicles that are at least California Certified Low Emission Vehicles (LEV) or attains at least 30 miles per gallon in fuel efficiency (DEP, 2004). In contrast, the remaining labels could be classified as hybrids of the Type I and Type III labels. While all labels did serve as an eco-seal, indicating that the vehicle has passed the above standard, each remaining label also presented additional information on the specific attributes of the vehicle, which is a primary characteristic of Type III labels (DeCicco 2003). The diverse labeling system allows future analysis to look at two factors that affect a label's effectiveness: amount of information presented and consistency of presentation, as all labels contain the eco-seal.

Section VI provided the primary data for this analysis. In this section respondents were asked to respond to a two-stage choice scenario; the two stages are designed to reflect the two-stage process of vehicle purchasing. This two-stage choice scenario is contained in Figure 2.

Figure 2. Two-Stage Vehicle Choice Scenario



In the first stage respondents are provided with average prices, miles per gallon and average scores for both criteria pollutants and greenhouse gases (referred to in the survey, and hereafter as "Global Warming Gases") for each vehicle class, as in Figure 3 below:

Figure 3. Sample First Stage Scenario: Class Selection

	Cars	Station wagons/ Mini-vans	Sport Utility Vehicles	Pickup Trucks
Average price	$29,550	$21,880	$27,330	$20,250
Miles per gallon	29	21	20	17
Air pollution scores (0 = Dirtiest, 10 = Cleanest)				
Criteria pollutants	7	3	2	1
Global warming gases	7	5	3	4

The averages used in this section of the survey instrument were generated from two primary sources. The average vehicle prices for each class were calculated from the National Auto Dealers Association's Guides (NADA.com, 2004). Based

on the standard deviation in price for each class, a range of averages was generated in two hundred dollar increments. The average criteria pollutant score for each vehicle class was calculated based on the United States Environmental Protection Agency's 'Green Vehicle Guide' (EPA, 2004). Based on the averages for each class, a range of average criteria values was generated in increments of one. Additionally, the following condition was imposed: the average price of a vehicle is positively correlated with average criteria pollutants scores (i.e. higher prices are associated with higher criteria pollutant scores implying cleaner vehicles). The average miles per gallon were also calculated from the EPA 'Green Vehicle Guide'. Based on the averages for each class, a range of average miles per gallon values was generated in increments of one. This calculated average was positively correlated (an imposed condition) with average global warming gas scores, which were also obtained from the EPA 'Green Vehicle Guide'. Based on the averages for each class, a range of average global warming gas scores was generated in increments of one. Table 4 depicts the averages described above. The ranges of averages for all attributes were randomized across all surveys. Columns of random numbers were generated using Excel's random number generator (uniform distribution) next to each vehicle class's average range. The columns that contained the average values were then sorted by the randomly assigned numbers.

Table 4. Average Product Price and Attribute Scores

Vehicle Type	Price ($)			Miles per Gallon			Criteria			Global Warming Gases		
	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max
Car	25,125	19,950	30,150	24	18	32	5	3	7	5	3	7
Truck	24,983	19,850	30,050	20	15	25	3	1	5	3	1	5
Station	25,094	20,080	30,080	21	17	25	5	3	7	5	3	7
SUV	30,106	25,130	35,130	19	15	24	3	1	5	3	1	5

An additional component of the first stage scenario included the random assignment of environmental information on the effects of global warming gases and criteria pollutants (herein referred to as "the information treatment"). The assignment was 0/1 in nature that is either a respondent saw all of the information or none of it. The information treatment was incorporated into 50.2 percent of the surveys distributed (see Table 3). The information contained in the treatment was based primarily upon material obtained from the EPA's 'Air Toxics, Health and Ecological Effects' website, in an effort to provide survey participants with accurate consumer-friendly information (EPA, 2003). Figure 4 contains the information treatment as viewed by survey participants.

Figure 4. Information Treatment

Below is a description of the air pollutants produced by vehicles

Criteria Pollutants
* Can form smog and leads to the formation of acid rain. Acid rain can damage or kill forests and fish habitats.
* Smog can reduce visibility, aggrevate asthma and cause coughing and difficult or painful breathing. Repeated exposure may cause lung damage.

Global Warming Gases
* These gases will trap the earth's heat and may change Maine's climate. For example, sea levels may rise and lead to flooding.
* Climate changes could increase the number of heat-related illnesses and deaths.

Respondents were then asked to choose a class of vehicle, given the information presented in Figures 3 and 4 (if treatment was present). Given their response to the first stage scenario, respondents were then directed to the second stage scenario, which involved choosing one vehicle within a class (refer to Figure 2).

In the second stage scenario participants were asked to choose a vehicle from a choice set of three (3) vehicles from the chosen vehicle class. Respondents were asked to assume that all vehicles were exactly the same except for the information presented regarding price, miles per gallon, criteria pollutants and global warming gases, as in Figure 5. It should be once again recalled that the imposed conditions dictates that price of the vehicle and criteria pollution score are positively correlated, as are miles per gallon and global warming gases (i.e. higher miles per gallon are associated with higher global warming gas scores). Respondents were asked to select one of the three options, however respondents were also presented the option of not choosing any of the vehicles presented. If rejection of the choice set was selected, information was then collected on the reason for rejection.

Figure 5. Sample Second Choice Scenario: Vehicle Selection within Class

	CAR X	CAR Y	CAR Z
Price	$30,350	$29,550	$29,050
Miles per gallon	34	29	24
Air pollution scores (0 = Dirtiest, 10 = Cleanest)			
Criteria pollutants	8	7	3
Global warming gases	10	7	5

It should also be noted that in the second choice scenario, vehicle Y always displayed the average price and scores seen in Figure 3. This was held constant in order to present the respondent with a status quo option in their choice set. Additionally, vehicle X consistently showed the most expensive vehicle with the best miles per gallon and pollution scores while vehicle Z invariable depicted the

cheapest vehicle with the lowest miles per gallon and scores. The average price, miles per gallon, criteria scores and global warming scores for each class across vehicles X, Y and Z are contained in Table 5. As the question asks respondents to simultaneously evaluate the three choices, ordering bias is not of concern.

The final section of the survey, Section VII, was focused on obtaining information on the demographic characteristics of the respondent. Questions in this section included gender, ethnicity, age, education and income. Additionally a number of behavioral characteristics were sought, where respondents were asked to identify outdoor recreation activities that they participated in and name any environmental organization to which they contribute. The information obtained from this section will be incorporated into the analysis as possible contributing factors in the willingness to purchase environmentally friendly products.

Table 5. Average Price and Attribute Scores Across Vehicles X, Y, Z

Vehicle Type	Price ($)			Miles per Gallon			Criteria			Global Warming Gases		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
Car	25,689	25,125	24,561	30	24	19	7	5	3	8	5	2
Truck	25,547	24,983	24,419	25	20	15	5	3	1	6	3	1
Station	25,658	25,094	24,530	26	21	16	7	5	3	8	5	2
SUV	30,670	30,106	29,542	25	19	15	5	3	1	6	3	1

Chapter 5

EMPIRICAL MODELING AND RESULTS

In order for eco-labeling initiatives to meet the greatest level of success (i.e. result in the largest number of consumers choosing eco-labeled vehicles), the marketing of the labels must be targeted to the audience most likely to respond to the labels. A concrete understanding of those factors that primarily influence a consumer's assessment of eco-labeled vehicles must be established. This understanding is motivated by the theoretical indirect utility function, including the vector of a consumer's personal characteristics noted as **C**. This analysis will consider the effect that the personal characteristics of a consumer may have in promoting environmentally responsible purchase behavior in response to eco-labels.

The results generated by this thesis may, in future studies, be used to estimate a consumer's willingness to pay for an eco-labeled vehicle; where the eco-label signals an improvement in the emission of such vehicles. However, in order to perform willingness to pay estimates, this study must first determine what individual and informational factors influence the values that consumers hold for improvement in environmental quality. Thus, the primary goal of this study is to develop an appropriate empirical model that identifies the variables that influence consumer purchase decisions.

This study deviates from previous studies in its focus on traditional fueled vehicles, and inclusion of personal perceptions as explanatory variables in the environmentally conscious purchase decision. Thus the path to develop an

appropriate empirical model for the situation at hand faced unique challenges. The process of developing the appropriate empirical model may contribute to the economic literature in its own right, and will be discussed at length in this study. This study will focus on: a) how existing literature guided modeling efforts, b) the estimation methodology employed and the limitations faced, c) the need for testing a subset of the sample and the procedures implemented, d) how the empirical model was modified to incorporate additional explanatory information and finally e) the specifications of the final empirical model and the results generated.

Guidance from Existing Literature

A majority of previous studies in the field of eco-marketing have investigated the sale of smaller, non-durable items, where eco-options are often purchased as a means of cost savings (such as Energy Star products). As this research focuses on the sale of a large ticket, durable items the available literature was not always applicable to the current study.

The literature reviewed suggests a myriad of possible explanatory variables involved in the purchase decision, ranging from the traditional set of demographic characteristics to the more recently examined role of perceptions and social norms in the purchase decision. As this analysis focuses on the role of personal views and perceptions as factors in consumer decision-making, the existing literature in the fields of economics and environmental psychology was particularly valuable in developing the empirical model. The literature on eco-choice suggests two distinct possibilities for the role that personal views may have

in the purchase decision. One school of thought indicates that a person's general view of the environmental and their personal ability (PCE), and that of others (FIO), to change environmental quality will play a major role in the purchase decision (Ellen et. al, 1991; Berger and Corbin, 1992; Bamberg, 2003). An alternative group of literature indicates that a person's view of the particular environmental issue at hand is a better predictor of their purchase behavior than demographics alone or general perceptions (Thogersen, 1999; Hini et. al, 1995; Webster, 1975). Additionally, some literature suggests that general environmental views may be important determinants in early stages of purchase, while views of the particular eco-labeled good may influence later stages of purchase behavior in the move from conventional to eco-labeled products (Grankvist, 2003). These two groups of literature began to suggest that explanatory variables based on perceptions be included in a conceptual model. Previous studies also indicate that personal attitudes and beliefs may lead consumers in identical scenarios to different outcomes, as behavior is thought to be jointly determined by conditions and the way people understand these conditions (Stern, 1999). This motivates the possible use of interaction terms in modeling the purchase decision.

The two-stage choice scenario (refer to Figure 2) presented to respondents suggests that variables appropriate for explaining consumer choice in stage one may not be appropriate in accounting for choices made at the second stage, thus the theoretical model discussed in Chapter 3 will be divided into separate constructs for each stage for any one individual's choice. However, the literature

does not provide concrete guidance regarding the stages at which certain variables may be significant, nor what form the variables may take. In accordance with the theoretical framework put forth in equation (3), the empirical model currently suggested by existing literature can be conceptualized as follows:

(6) **Class Choice** [C_j] = function of: Vehicle Use, Demographic Variables, Average Class Price, Global Warming Emissions Score, Criteria Emissions Score, Perceptions/attitudes regarding:
- General environmental concern/knowledge
- Specific environmental concern/knowledge (i.e. air quality)
- Eco-labeled vehicles as apt substitutes
- Consumer effectiveness [Faith in Others (FIO) and Perceived Consumer Effectiveness (PCE)]

(7) **Vehicle Choice** [$C_{k/j}$] = function of: Demographic Variables, Vehicle Price, Global Warming Emissions Score, Criteria Emissions Score, Perceptions/attitudes regarding:
- General environmental concern/knowledge
- Specific environmental concern/knowledge (i.e. air quality)
- Eco-labeled vehicles as apt substitutes
- Consumer effectiveness [Faith in Others (FIO) and Perceived Consumer Effectiveness (PCE)]

Where all variables, except vehicle use and price, may be interacted with the emissions information presented on the eco-label (global warming and criteria scores) to determine if reaction to the environmental information is homogeneous across consumers.

Estimation Methodology and Limitations

In order to continue development of the appropriate empirical model, we should identify the most suitable estimation techniques, and detect any limitations that may be faced in estimating the outlined conceptual model. As the choice scenario presented to respondents was two-stage, the choice of vehicle was conditional upon the choice of class and rejection of the other vehicles within the

class set. Given the two-stage nature of the choice, a multinomial logit estimation (MNL) would not be sufficient as the MNL does not allow for the possibility that standard deviation of the random error term (ε) in the utility expression could be different across alternatives in the choice set (Hensher and Greene, 2002). To account for this possibility, the nested logit technique introduces a scale parameter associated with each utility expression. This scale parameter relates the conditional choice (vehicle choice) back to the original choice set (class choice). Thus nested logit would be the most appropriate technique in estimating the results for this data set and Limdep the most appropriate statistical software for the analysis. Additionally, this two-stage approach enabled the survey to be constructed with a realistic "hold all else constant" choice scenario. As survey participants were asked to simultaneously evaluate the choice set, while holding all else constant except the provided environmental and price information (i.e. price, mpg, criteria and global warming scores per Figures 3 and 4 of Chapter 4) it is unrealistic to ask respondents to evaluate vehicles from different classes under the "hold all else constant" assumptions.

With respect to the nesting structure, previous investigations indicate that the partitions of nests should be mutually exclusive subsets where alternatives similar in unobserved characteristics (i.e. possible correlation of the ε term) are included in one nest (Univ. California). This nested structure is a partial solution to the strong assumptions of Independence of Irrelevant Alternatives (IIA), where errors are assumed to be uncorrelated across all alternatives (Kling and Thomson, 1996). By nesting similar alternatives that may serve as close substitutes, such as

vehicle classes, the IIA assumptions hold within a particular nest, where a change in attributes of one alternative will draw proportionately from other alternatives with in the nest (Univ. California). Unfortunately the existing literature provides no further guidance for specifying a nesting structure. However, the nesting structure outlined in Chapter 4 (Figure 2) is consistent with the criteria for nesting alternatives outlined above and also allows for variables to enter the model at multiple levels, as implied by the conceptual model.

It is a goal of this research to determine if consumers are willing to consider eco-labeling information in choosing a class of vehicle, or if they will *only* consider this information once they have selected a particular class. This two-stage decision process further motivates the use of the nested logit estimation technique. The equation for estimating vehicle choice can now be written, in accordance with Hensher & Greene's (2002) standardized notation for nested logit functions as[3]:

$$\textbf{(8)} \qquad P(j) = \frac{\exp[\delta' \mathbf{z}(j) + {}^{1}/_{p(j)}\, IV(j)]}{\exp(IV)}$$

where P(j) is the probability of selecting class j; δ is the vector of parameters at the class choice level, and **z** is the vector of explanatory variables. Thus P(j) is the probability that class j is chosen at the first stage.

[3] The models contained in this study were estimated using Random Utility model 2 (RU2) discussed at length in Hensher & Greene (2002). This normalization technique is more appropriate for the data at hand, as one would expect greater variation at the attribute level (μ) than at the branch level (λ). Additionally, given that parameters in the final model appear in several nests if RU1 was employed, where normalizing occurs from the lower level, these repeating parameters would be scaled differently for each nest. It is thus more appropriate to fix λ during estimation, as allowed for by RU2. The inclusive values reported with the empirical model are solely μ. The value of $1/\mu$ must be calculated prior to determining if these values are consistent with utility maximization requirements of $0<IV<1$.

$$(9) \qquad P(k/j) = \frac{\exp[\mu(j)[\alpha k/j + \beta' \mathbf{x}\,(k/j)]]}{\exp IV(j)^{4}}$$

where P(k/j) is the probability of choosing alternative k given that choice j has already been made; β is the vector of parameters at alternative k level and **x** is a vector of explanatory variables. Thus the P(k/j) is the probability that vehicle k will be chosen, given that class j was selected in the first stage.

Development of Model

Of particular importance in developing the empirical model is the lack of guidance on whether variables previously noted as important in other eco-choice studies will actually significantly affect the vehicle purchase decision. Due to the varied findings in the literature regarding the role of age and education in eco-choice decisions, these two variables will be excluded from further modeling. In review of the data the variable gender was also deemed inappropriate for inclusion in further modeling. All respondents who chose the van class were female, and it was feared that this high correlation would bias parameter estimates should gender be included in the model.

During initial attempts to replicate the conceptual model, a great deal of instability in the models was noted. In re-examining the data it was noted that no respondent had chosen the Van Z option. This result indicated that it was not appropriate to have van as a separate nest, due to the lack of variation in the data. A change to the nesting structure was necessary, but initial uncertainly arose in determining the appropriate re-nesting structure. In returning to the survey design stage of our research, it was noted that our contact within the Maine Automobile

[4] IV(j) is the inclusive value parameter defined as: $[\lambda(k/j)]/[\mu(k/j)]$

Dealer's Association had indicated that Station-wagons/Vans were generally considered substitutes for either cars or SUV's. Clearly the nests must be restructured in order to contend with the insufficient variation in the van data, due to the lack of vehicle Z selections.

In reconfiguring the nesting structure, a preliminary model was run under two different nesting structures: a) where van and car were nested and b) where SUV and van were nested. The modeling results indicated that the van and SUV nest was inappropriate, as the inclusive value parameters became extremely large, indicating a lack of proper substitutability within the nest. The results indicated that the new nesting structure where van and car were nested was far more appropriate and stable than any previous nesting efforts. Additionally, this nesting structure continued to be consistent with the criteria for nesting alternatives as the structure nests alternatives that may serve as close substitutes.

As previously discussed, existing literature did not provide guidance on how the explanatory variables representing personal characteristics may enter the model, either in form or in the nesting structure. Thus one must initially assume, based on the conceptual model, that all personal characteristic variables could have explanatory power at both levels of the nest, as depicted in the conceptual model. However, moving forward under this assumption was of great concern.

The apprehension surrounding the uncertainty of the model arose from three factors. First, the concern of adding too many irrelevant consumer specific variables and possibly increasing standard errors, Type II errors and the unreliability of parameter estimates arose. Second, it was recognized that using

too few of the outlined personal variables could lead to dropping relevant variables which would result in biased coefficient estimates. Finally, the Limdep software utilized in preparing the empirical model limited the number of parameters included in a nested logit model to thirty. Clearly if all demographic characteristics were included from the conceptual model for each vehicle class, this would exceed the software's capability. In an effort to simultaneously address these problems the decision was made to perform some preliminary analysis of the conceptual model with a subset of the full sample.

To obtain the appropriate sub-sample a number of steps were followed. First, a limitation arose in that the full sample only consisted of 620 observations and clearly if too small of a subset was drawn it would be insufficient for estimation. Thus complete observations, which represented 90% of the full sample, were used to perform the subset testing. Due to the discrete nature of the conjoint scenario, each observation has twelve lines of data that corresponds to it (0/1 to each of the 4 class choices, and then 0/1 for each of the three vehicle choices). Thus of the 5928 lines of data, 90% of this is 5335. However, 5335 is in the middle of an observation (i.e. a set of twelve), and in order to maintain complete observations, the data line 5340 was utilized as the end of the subset. In order to ensure accuracy a second subset of complete observations from the sample (lines 589 to 5928) was also employed to double check all findings from the testing described below.

In order to test the initial assumption that all the interaction variables involving personal characteristics (formerly defined in subsequent sections) could

have explanatory power at both levels of the nest, as depicted in the conceptual model, a log likelihood ratio test was employed. When implemented in Limdep, the software will calculate a chi-squared statistic for the model under restrictions and with no restrictions. This statistic (referred to as an LRStat) is reported in conjunction to the chi-square table value for the appropriate degrees of freedom. The degrees of freedom are dependent upon the number of parameters removed from the unrestricted model in creating the restricted model. When the calculated LRStat exceeds the chi-square table value, this is evidence that the set of variables in question are significant. For the preliminary analysis, the unrestricted model was identical to the conceptual model where all variables except vehicle use and price were interacted with the emission scores. This model excluded the previously discussed variables of age, education and gender. The restricted model consisted of no interaction terms at the class level. A log likelihood ratio was computed, where the degrees of freedom equaled ten and the confidence level was 90%, as the chi-squared test is a one-tailed test. The results of this log likelihood ratio indicate that the set of interaction variables are inappropriate at the class level (LRStat=7.55, $\chi 2$=15.99). The results suggest that consumers with different personal attributes respond homogeneously to the emissions information presented at the class level, as evidenced by the lack of significance for the interaction terms at the class level. These findings conform to earlier suppositions that class level decisions are generally motivated by prior knowledge and perceptions. Thus in further development of the model, the set of interaction terms will no longer be included at the class level.

In order to test the inclusion of vehicle level interaction terms, a similar log likelihood test was performed on all vehicle level interaction variables, where the degrees of freedom equaled ten. In accordance with the results from the above test for class level interactions, the new unrestricted model consists only of the non-interacted variables at the class level (i.e. intercept, price, vehicle use, class level criteria scores and class level global warming scores). The restricted model removed all vehicle level interaction terms. The results of the test indicate that vehicle level interaction terms are significant for the current estimation and should be retained during future modeling (LRstat=99.59, $\chi 2$=15.99).

The above tests leave one additional important question: what is causing the vehicle level interaction terms to be significant? Two final tests were employed to respond to this question. First, a log likelihood ratio was utilized to determine if the sum effect of the global warming interactions were significant in explaining respondent choices. The unrestricted model included the aforementioned class level variables and all interaction terms at the vehicle level. The restricted model removed all global warming interaction terms. The test results indicate that the interaction terms are not important in explaining reactions to the global warming scores (LRstat=4.66, $\chi 2$=10.65). Second, a similar log likelihood test was employed on the criteria interaction terms. Here the restricted model removed all criteria interaction terms. The criteria interaction terms are significant in explaining different reactions to the criteria pollution scores according to the results of this test (LRstat=22.27, $\chi 2$=10.65). These preliminary results suggest that consumers homogeneously respond to the global warming pollution scores,

but have heterogeneous reactions to the criteria scores that vary with their personal perceptions.

Recall that in developing this empirical model, a subset of the sample was employed. Upon completion of the preliminary analysis and nest re-structuring, the final empirical model, as developed above, was estimated using the full sample to ensure accuracy. This model looks remarkably different from the conceptual model outlined in (6) and (7). Thus it appears that the process of developing the proper empirical model, with which to estimate willingness to pay, may be a contribution to the eco-choice literature. The final empirical model, with estimation results reported in Table 10, for any one individual's choice can be formalized as:

(10) **Class Choice** $[C_j] = \sum\gamma_{1j} + \sum_j\gamma_{2j}(\text{Use1}) + \sum_j\gamma_{3j}(\text{Use2}) + \gamma_4(\text{total annual cost}_j) + \gamma_5\text{Crit}_j + \gamma_6\, GW_j$

(11) **Vehicle Choice** $[C_{k/j}]$: $\sigma_1(\text{total annual cost}_k) + \sigma_2 GW_k + \text{Crit}_k*[\sigma_3 + \lambda_1(\text{allsame}) + \lambda_2(\text{carpercep}) + \lambda_3(\text{PCE}) + \lambda_4(\text{FIO}) + \lambda_5(\text{concern})]$

Explanation of Variables- Class Choice

Cj is a discrete choice variable indicating an individual's choice of the jth class (either car, van, SUV or truck); 1 denotes the product was chosen, 0 otherwise. The intercept terms, denoted as γ1, are employed as a means of capturing other unobserved class specific characteristics that differ between classes but may otherwise not be captured within this model. Maintaining consistency with the findings of Thogersen (2000b), this study also recognizes

that vehicles are purchased for their perceived utility, including the ability of a vehicle to perform certain tasks , as captured by the variables Use1 and Use2. Respondents who require their vehicle for hauling or occupational purposes will most likely choose a truck or SUV over a vehicle less suited to these tasks such as a car. The variables Use1 and Use2 were created from respondents' answers on a five point Likert scale requesting level of agreement to how important certain uses were in the purchase decision. Averaging responses to commuter-based questions created Use1, while averaging responses to hauling based questions created Use2 (see Appendix A to view questions 12a, b, c and d). In discussing the a priori expectations for the parameter estimates, the reference group for this analysis was the truck nest. Thus, a positive coefficient is expected on Use1 where people who require a vehicle for commuter uses are *more* likely to choose the car or SUV class in relation to the truck class. The same reasoning leads to a negative parameter expectation for Use2; people who require a vehicle for hauling are *less* likely to choose the car or SUV class over the truck class. It should be noted that neither Use1 nor Use2 are interacted with the environmental scores. Given that consumers have previously purchased traditional fueled vehicles, they hold preconceived notions regarding the different vehicle classes. Of particular importance, is the fact that consumers hold a stock of prior knowledge regarding the capabilities of the vehicle to perform various duties.

In the survey, respondents were presented with two pieces of environmental information for each vehicle class in the survey. The variable $Crit_j$ is the average criteria pollutant scores for a class while GW_j is the average global

warming gases score for a class. Both scores were presented on a scale of 1 to 10 to respondents, where 10 represented the cleanest emissions record. It is expected that the coefficients on $\underline{Crit_j}$ and $\underline{GW_j}$ will be positive indicating that higher scores (i.e. improved emissions) will increase likelihood of purchase. This indicates that consumers will be more likely to buy a particular class, as it's environmental quality attributes increase.

In order to capture the price effects facing vehicle consumers, this study incorporated a number of factors into a 'total annual cost' variable intended to accurately reflect the true costs of purchasing a vehicle, and serve as a base for willingness to pay estimates. As noted by Morey et. al. (2003), willingness to pay is partially determined by ability to pay, where ability to pay is a function of both price and income. Income (INC) in this data set was collected as categorical data. Respondents were asked to identify their income level in one of ten categories. An average income was then calculated for each category, for example the category of $50,000 to $59,999 was transformed to it's average of $55,000, and this average was utilized as the income variable.

With regard to price, survey respondents were presented with average price information for each vehicle class during the first section of the conjoint scenario. However, the presented information was obtained from "sticker price" information whereas a majority of consumers finance their vehicle purchases through an annualized payment plan, usually at a constant interest rate over a five-year period. In order to incorporate this more reasonable price effect, Microsoft Excel's payment calculator function was employed to create annualized payment

for each individual in the data set, where the interest rate was set at 6%. Additionally, Rubin, Leiby and Greene (2004) note that the price of a vehicle to a consumer includes insurance and tax costs. Thus the price construct must be modified to incorporate these additional costs. In accordance with information from the Automobile Association of America (AAA), annual payment costs, tax and insurance costs add up to approximately one third (.353) the vehicle's total annual cost. Thus the price presented in the survey was adjusted by 35.3% to reflect annual payments, tax and insurance costs and is denoted as APP, annual purchase price. A second set of costs associated with vehicle purchases are the fuel, maintenance and tire costs (Rubin et. al. 2004), where maintenance costs are generally positively correlated with the number of miles driven. To capture these costs, an annual cost of driving (ACD) was created utilizing the following formula:

$$ACD = (1/mpg) \times miles \times CPG \times 1.93$$

Where mpg is the average miles per gallon for a particular vehicle class viewed by survey respondents (provided as in Table 4), miles denotes the annual number of miles driven as reported by respondents, CPG is the cost per gallon of gasoline during the time of the survey (the research team had been tracking Maine gasoline fuel prices throughout the time of survey implementation, and was able to ascertain that the average price per gallon during the summer of 2004 was $1.95) and finally the 1.93 was included to weight the annual gasoline costs in order to include annual maintenance costs (including tires). Finally, to capture all of these effects at the class level, a composite variable total annual cost$_j$ was utilized

to capture the three factors influencing a consumer's ability to pay at the class level where:

Total annual $cost_j$ = [INC-APP_j-ACD_j]/1000

The division by 1000 was necessary to eliminate scaling effects as a majority of the variables range from 0 to 10, while prices and income were reported in the tens of thousands. It is expected that the coefficient associated with total annual $cost_j$ will be positive, indicating that as the difference between income and costs increases, the likelihood of purchasing a particular class of vehicle will increase.

Explanation of Variables – Vehicle Choice

$C_{k/j}$ is a discrete choice variable indicating an individual's choice of the kth vehicle (either X, Y, Z) given that they have already selected class j. In discussing a priori expectations, the interpretation of coefficients is altered from that of the class level. At this stage of the nest, a positive coefficient indicates an increased likelihood of purchasing a particular vehicle in the choice set conditional on the class being previously chosen.

The vehicle level model includes a number of interaction terms not previously discussed at the class level. These interaction variables were included within this model in order to test the effect that various personal characteristics and views, from the **C** vector, may have on a consumers' use of the environmental information. As all personal characteristic variables at the vehicle level are interacted with $Crit_k$ we must first define this variable. $Crit_k$ is the criteria pollutant score for each individual vehicle within a respondent's chosen class while GW_k is the global warming gases score for each individual vehicle. Similar

to $\underline{Crit}_k$ and $\underline{GW}_k$, these scores were presented on a 1 to 10 scale, where 10 indicated the cleanest emission record.

In order to continue discussion of vehicle level variables, one must consider the make up of the variables involved in the aforementioned interaction terms. Three of these variables are the result of a factor analysis performed on survey participants' responses to attitudinal questions. Factor analysis was used in order to determine if any underlying commonalities existed in participants responses. The factor analysis indicated that in responding to the nine-attitudinal questions, three distinct underlying factors influenced their responses. Factor one indicated a faith in others (FIO), while Factor 2 was related to a consumer's perceived consumer effectiveness (PCE). Factor 3 captured the respondent's views on the perceived compromise required in purchasing an eco-labeled vehicle. The factor patterns identified above were used to create the variables PCE, FIO and Carpercep, which will be further discussed below.

In order to best interpret results from parameter estimates and hypothesis testing, variables must be confined to values on only one side of zero (i.e. values that are all positive or all negative). In order to determine if any variables utilized in the empirical model require transformations (i.e. confine their values to one side of zero), descriptive statistics were run on all pertinent variables as shown in Table 6. The transformations are also required to determine the mean, and extreme values for each personal characteristic in order to perform additional linear hypothesis testing. As evident in Table 6, three of the five terms ranged from a negative minimum to a positive maximum. In order to ensure accuracy,

transformations of each of the three variables were performed *prior* to running the final empirical model. An example of such a transformation is the variable Faith in Others (FIO), which will be further discussed below. Faith in Others responses were all adjusted by 2.8199 in order to ensure that the minimum response is equal to zero, and no longer negative. The adjusted minimum and maximum, where appropriate, are included in parenthesis in Table 6.

Table 6. Descriptive Statistics of Variables Interacted with Criteria

Variable	Mean	Std. Deviation	Minimum	Maximum
All Same	.59	.49	0.0	1.0
Faith in Others	.11	.99	-2.82	3.17
			(0)	(5.99)
Perceived Consumer	.05	.99	-3.54	2.18
Effectiveness			(0)	(5.72)
Green Vehicle Perception	.0007	.99	-2.80	2.63
			(0)	(5.43)
Concern for Air Quality	3.66	1.06	1.0	5.0

In continuing to define the terms utilized at the vehicle level, we must recall some of the effects this analysis looks to investigate. This study hypothesizes that concern and/or knowledge about a specific environmental resource and its link to the product under consideration will significantly affect a consumer's purchase decision. The air quality variables included in this analysis attempt to capture both a person's concern with Maine's air quality degradation as well as their knowledge regarding the link to passenger vehicles emissions. To assess the familiarity of a respondent with the link between air quality degradation and passenger vehicle emissions, the variable Allsame will be employed. Survey respondents were asked to identify the class of vehicle they felt polluted the most,

and were also presented with an option that all vehicle classes pollute the same. If a respondent selected this option, the variable Allsame takes the value of one, and zero otherwise. It is hypothesized that those individuals who do not recognize that vehicle classes differ in their contribution to air quality degradation (i.e. Allsame = 1) will be less likely to choose a vehicle with cleaner emissions profiles.

A second air quality variable is included to capture the affects that concern over air quality degradation may have on the purchase decision. This variable 'concern' was obtained from participants' responses to the question "How concerned are you about Maine's air quality" on a Likert scale. A response of five (5) indicates a high level of concern for Maine's air quality, while a one (1) response denotes the participant is "not at all concerned". It is hypothesized that greater concern for Maine's air quality will increase the likelihood that a consumer will purchase a vehicle with a cleaner emissions profile.

A consumer's perception of the vehicle they are purchasing will also no doubt affect their purchase decision, as captured by the variable Carpercep. If a consumer perceives that an eco-labeled vehicle is not an apt substitute for their normal vehicle, they will be less likely to purchase an eco-labeled vehicle (i.e. negative coefficient on carpercep is expected). This variable was created utilizing the factor analysis scores discussed above. I also contend that consumer's with greater perceived consumer effectiveness (PCE) will be more likely to purchase an eco-labeled vehicle (i.e. positive coefficient on PCE). The variable PCE was also created utilizing the factor analysis scores, where responses to three questions

regarding a respondent's view of their personal ability to affect the environment through purchase decisions in either a positive or negative light appeared to share underlying commonalities.

The variable faith in others (FIO) attempts to capture the affect that faith-in-others may have on the purchase decision. Consumers with a higher faith in others may be more likely to purchase an eco-labeled vehicle as they feel their pro-environmental choice may be part of a larger effort, however there may also exist an incentive to free-ride and thus the expected sign on FIO is ambiguous. This variable was constructed in a method similar to PCE, where responses to attitudinal questions on a Likert scale were analyzed during the factor analysis.

Finally, total annual cost at this stage reflects costs for particular vehicles within a class choice set, and thus total annual cost at the vehicle level must be denoted total annual $cost_k$ to differentiate it from the total annual cost variable at the class level. To reiterate, the following variables are expected to increase the likelihood of purchasing a particular vehicle (i.e. expect positive coefficient): $Crit_k$, GW_k, concern, total annual $cost_k$, PCE. Negative coefficients are expected on allsame and carpercep while the coefficient for FIO is ambiguous. The results generated from the modeling outlined above are contained in Table 10.

Robustness of Final Model

Prior to examining and interpreting the empirical modeling results, this study should first scrutinize the strength of the model based on traditional measures of robustness. With respect to measures of goodness of fit for nested logit modeling, there is no universally accepted measure of goodness of fit (Kennedy,

2003). The traditional technique is to apply log likelihood ratio testing to test the null hypothesis that all parameters are not significantly different from zero. The test statistic for the empirical model outlined above can be written as:

$$\lambda_{LR} = 2[(-787.9946) - (-1078.661)] = 581.3329$$

In comparing the above test statistic to the chi-squared for twenty degrees of freedom ($\chi 2 = 39.9968$), this study confirms that the model passes the log likelihood goodness of fit requirement.

With nested logit models a number of additional factors ought to be considered in determining the strength of the model. The additional considerations include (a) calculating the inclusive values to ensure consistency with utility maximization and (b) calculating the correlation of utilities coefficient to ascertain appropriateness of nesting structure. As noted previously, given the RU2 specification employed in this study, the inclusive values reported with the regression output are the μ of the inclusive value parameter λ/μ, where $\lambda=1$. Results show that the inclusive values for each nest are between 0 and 1, which indicate consistency with utility maximization (Table 7).

The model must now be examined with respect to the correlation of utilities coefficient. This coefficient measures the correlation between the unobserved factors within a nest. If the coefficient indicates strong correlation between the unobserved factors, this indicates that the nesting structure is appropriate, as close substitutes are contained within one nest. This coefficient is particularly important to review given that the nesting structure was adjusted during development of the model. Clearly, an appropriate nesting structure

would yield correlation of utilities coefficients close to one, indicating close correlation. Applying the formula for the correlation of utilities coefficient [1-$(IV)^2$] to the inclusive values (IV) indicates that the nesting structure was appropriately specified (Table 7).

Table 7. Inclusive Values and Correlation of Utilities Coefficients

Nest	μ	Inclusive Value ($1/\mu$)	Correlation of Utilities Coefficient [1-$(IV)^2$]
Car/Van	2.610	.38	.8556
SUV	1.613	.62	.6168
Truck	2.347	.42	.8236

Given that the above section indicates that the empirical model meets measures of goodness of fit, and measures of robustness it is now appropriate to review the results and determine any implications of the model.

Interpretation of Final Model

Class Level

These results conform to some a priori expectations that class decisions are primarily based on attributes that consumers have prior information on, such as uses for the vehicle (Table 8). Given that the commuting and hauling variables are significant for both the SUV and car/van nest with respect to the reference group of the truck nest, this indicates the importance of use in the class purchase decision. The significant positive sign on the commuter use variable (use1) indicates that consumers who feel that commuting is important to their purchase decisions, are more likely to purchase an SUV or a car/van relative to the truck class. The significant and negative coefficient on the hauling use variable (use2)

indicates that consumers who feel that hauling is important in their purchase decisions are less likely to purchase an SUV or car/van relative to a truck.

The insignificance of the two emission scores reveal that people generally do not consider environmental information when making their class level decision. With respect to preliminary policy ramifications from these results, policy makers should recognize that emissions information will generally not cause consumers to "jump nests", that is change class of vehicle. Thus policy makers should focus future eco-labeling programs on identifying to consumers those vehicles within a class that are environmentally preferred.

We must also consider that consumers may already hold preconceived notions about additional aspects of certain classes. The class level results indicate a negative and significant parameter estimate for the SUV intercept term. This indicates that all else held equal, Mainer's would prefer to purchase a vehicle from the truck reference group in lieu of an SUV. These results may be capturing some of the effects that recent adverse press regarding SUV's has had on consumer decisions. This study does not look to further speculate regarding the cause of preconceived notions, but recognizes the need to acknowledge them as a possible influencing factor in class level purchase decisions.

Table 8. Final Empirical Model Results

Variable	Coefficient	Standard Error	P-Value
	Class Choice		
Total annual cost	-.0957	.1776	.5901
Crit	.0415	.1368	.7619
GW	-1.513	.0733	.1149
	Car Specific Variables		
Intercept	-.3155	.6596	.6325
Use 1	.9277	.1529	.0000
Use 2	-.9879	.1350	.0000
	SUV Specific Variables		
Intercept	-1.513	.8679	.0813
Use 1	.6922	.1859	.0002
Use 2	-.5813	.1789	.0012
	Vehicle Choice		
Total annual cost	.1651	.0982	.0927
Crit	-.006	.0753	.9397
GW	.0977	.0577	.0904
CarPercep	-.0047	.0126	.7089
AllSame	-.0139	.0251	.5797
FIO	-.0063	.0014	.6420
PCE	.0188	.0169	.2683
Concern	.0175	.0154	.2546

Additionally, the results suggest that the total annual cost of driving and purchasing a vehicle is not a significant factor in the class level decision process. These results are logical when one considers the amount of overlap that occurs in vehicle pricing. Consumers prior stock of knowledge would presumably contain the information that vehicles in different classes can often have comparable prices (ex: small SUV and large car). Thus it is not surprising that the average class prices presented to survey participants were not significant given their utilization of prior knowledge regarding vehicle pricing and possible price overlap. These class level results once again conform to earlier suppositions that vehicles are primarily purchased for the utility they will provide.

Vehicle Level

Important implications are also suggested by the vehicle level results. These results indicate that the total annual cost of driving and purchasing a vehicle is a significant factor in the vehicle level purchase decision. The positive and significant coefficient indicates that as the difference between income, and the costs of purchasing and driving a car increases, the likelihood of purchasing the vehicle increases. These results are of particular importance for three reasons. First, the coefficient estimate can now be utilized in calculation of willingness to pay estimates for improvement in emissions. Second, it appears that the total annual cost of a vehicle is an important purchase criterion. Policy makers may be able to take advantage of consumers cost considerations in tying together an eco-labeling message with a monetary message to budget conscious consumers. For example, educating consumers regarding the link between better gas mileage and

lower fuel costs as well as improved global warming emissions records from this lower fuel consumption. Third, consumer's perceptions regarding the expense of eco-labeled vehicles should also be considered. If consumers erroneously perceive that eco-labeled vehicles are more expensive than their traditional substitute, they may not consider the eco-labeled vehicle during purchase decisions, as ability to pay (income) and cost are important factors in the purchase decision as suggested by the regression results.

A second important finding is that global warming scores, when provided on an eco-label as in the survey, are a significant factor in purchase decisions made at the vehicle level. The positive coefficient associated with the global warming variable indicates that as the global warming score increases (i.e. better emission records for global warming gases) the likelihood of purchasing the vehicle increases. This is an exciting result for policy makers, as it implies that consumers do value eco-information and are willing to incorporate such information into their purchase decisions for vehicles. It is of particular interest that consumers homogenously react to global warming scores, while results indicate that consumers have a heterogeneous reaction to criteria pollutant scores. The conclusion section of this thesis will further consider these interesting results. However, one must consider that criteria pollution scores are interacted with a number of other personal characteristics at the vehicle level. Perhaps it is the joint effect of personal characteristics and criteria scores that yield significance in the purchase decision. Clearly additionally hypothesis testing is required to investigate this possibility.

Hypothesis Testing and Descriptive Statistics

A primary difficulty arises in efforts to interpret the modeling results discussed above: how can interaction variables be interpreted? One must jointly consider the parameter of the interaction term *and* the parameter associated with criteria scores in order to determine if the joint effect is significant in the purchase decision. In order to investigate these possible joint effects, Wald testing was utilized where interaction parameters and criteria scores parameter were jointly tested. Table 9 shows the results of these Wald tests (i.e. each row indicates test results for one personal characteristic interaction parameter plus criteria scores parameter). While none of the individual Wald tests indicate that the joint effect of an individual interaction term and the criteria parameter are significant, previous log likelihood testing revealed that the joint effect of all of the interactions terms had a significant effect on purchase decisions.

Table 9. Results of Wald Testing

Crit + [Variable]	Wald Statistic	Probability ($\chi 2$)
AllSame	.07244	.78781
Carpercep	.02196	.88219
Trust	.02823	.86657
PCE	.03421	.85327
Concern	.02724	.86891

Given that personal characteristics affect a consumer's response to criteria scores, of additional interest is how consumers at the extremes of each personality

characteristic may react to the criteria emissions information. In order to test the possibility of differing significance of criteria information for various personal characteristics, linear hypothesis testing was employed. Three scenarios will be considered. First, the reported means of the personal characteristics will be tested to determine if criteria pollutant scores would be an important explanatory factor in the purchase decision of an 'average' respondent (i.e. allsame = .6, concern=3.7, carpercep=2.8, FIO=2.8, PCE=3.6). The linear test of this scenario indicates that criteria pollution scores would be an important explanatory factor in the purchase decision of an 'average' respondent ($\chi 2 = 21.74$, Sig. Level = .0000) Additionally, the following case was considered where a consumer was: a) knowledgeable about the link between air pollution and vehicle emissions (i.e. allsame=0); b) concerned about Maine's air quality (i.e. concern=5); c) felt that green vehicles were adequate substitutes for their usual vehicle (i.e. carpercep = 0); d) had faith in others willingness to assist the environment (i.e. FIO=6) and e) felt that they could make a difference with their individual purchases (PCE=6). A completed linear test of this scenario indicated that criteria pollution scores would be an important explanatory factor in the purchase decision of such a consumer ($\chi 2 = 8.27$, Sig. Level = .0040). However, when a consumer at the opposite extreme is considered (i.e. allsame=1, concern=1, carpercep=5, FIO=0, PCE=0) results suggest that criteria emissions information will not be important in explaining their purchase decisions ($\chi 2 = .57$, Sig. Level = .4496). These results have important policy implications in that if policy makers could influence some of these personal characteristics, for example regarding the link between air

pollution and vehicles, consumers would be more likely to consider criteria emissions information in their purchase decisions.

Chapter 6

DISCUSSIONS AND CONCLUSIONS

The results of this study provide several important insights. First, consumers will consider the emission profile of a vehicle during their purchase decision, if such information is provided. Second, consumers have mostly insignificant, heterogeneous reactions to criteria pollutant information, where differing personal perceptions affect consumer responses. In contrast, consumers have significant and homogeneous reactions to global warming pollutant information. A synthesis of how policy initiatives may be impacted or guided by these results will serve as a final component to this analysis.

Before discussing the topics outlined above, the limitations of this study must be reviewed. First, as with any conjoint scenario consumer responses may have been inhibited by the hypothetical nature of the questions. Previous studies have noted that when respondents do not face an actual budget constraint, they may not be as price sensitive as in real-market scenarios. Additionally, while the State of Maine has issued the Clean Car Label statewide, only 3.5% of our sample had any experience with the label. Moreover, this Clean Car Label does not contain specific emissions information, as was presented to survey respondents, and thus consumers do not have real market experience with emissions profiles associated with eco-labeled passenger vehicles. Caution is generally warranted when interpreting the results of a conjoint scenario, particularly one in which consumers have limited real-world experience. However, consumers do have real-world experience in purchasing traditional fueled passenger vehicles. If

participants of the survey felt that the scenarios posed to them were unrealistic based on their personal experience, they may have rejected the scenario entirely. An opt-out alternative was presented (i.e. "I would not choose any vehicle) in order to ensure that results were not based on conditional choices (i.e. forced to select one alternative), however few participants selected this option (Champ, et. al., 2004).

Given the results indicate that consumers consider information regarding the emissions profile of vehicles when making vehicle level purchase decisions, we must contemplate how to best provide this information. The current policy initiative in Maine has been to utilize a Type I eco-seal that denotes those vehicles (primarily in the car class) meeting the Clean Car program standards.[5] Four distinct limitations surround this program as identified by the results of this, and previous, studies. First, a consumer would need to invest time in gathering information about the standards associated with the Clean Car label in order to utilize the label in his/her purchase decisions. This is troublesome as only 19.6% of survey respondents indicated that they searched for emissions information prior to vehicle purchase, and of that group only 11.2% indicated that they visited the Maine Department of Environmental Protection's webpage (where information regarding the Clean Car Program is contained). The second limitation is that, as noted above, this label does not provide specific emissions information. Given that consumers react differently to global warming and criteria pollutants, this suggests that consumers note the individual pollutants listed on an emissions

[5] The Maine Clean Car Label denotes vehicles that meet the following standards: 1) obtain 30 miles per gallon or better in gas mileage and 2) are certified Low Emission Vehicles, or better (i.e. Zero Emission Vehicles).

profile. Failure to include specific emissions profiles limits a consumer's ability to utilize individual pollutant information in their purchase decisions. The consideration of specific emissions information by consumers could be due in part to the large-ticket, durable nature of vehicles. As vehicles are large-ticket durable items, consumers may invest more attention in considering the attributes of the vehicle relative to smaller ticket items. This attention to detail may be an underlying factor in why consumers consider specific environmental information for vehicle purchases. In order to best facilitate a match between consumers' information requirements, and eco-labeling policy proposals, the results of this study indicate that specific emissions profiles should be included on eco-labels intended for passenger vehicles.

A third limitation lies in the voluntary nature of the Clean Cars for Maine Program. Currently, no law exists that mandates participation in this program for Maine Auto Dealers. Previous studies indicate that such voluntary programs are less beneficial to consumers than compulsory eco-labeling programs. Compulsory labeling programs best achieve the goal of allowing consumers to rank products with respect to environmental attributes, and yield higher consumer satisfaction, than voluntary programs (Roe et. al., 2001).

Finally, a fourth limitation is that consumers do not react to environmental information at the class level. Given that environmental information is not considered at the class level the results suggest that consumers typically will not change the class of vehicle they intended to purchase based solely on environmental information. Thus an effective program would need to provide

emissions profiles for all vehicles allowing consumers to compare across class and across vehicles within a class in order to reach a larger market segment of consumers.

As the goal of the Clean Car program is to provide Maine citizens with the materials they need to express environmental preferences in their vehicle purchase habits, Maine may need to reconsider the current labeling efforts. Under the current program Maine consumers may be unable to fully express their preferences due to the limited information provided by the current labeling program. The current program only allows consumers intending to purchase a vehicle in the car class the opportunity to identify environmentally preferred vehicles within that class. The program does not provide adequate information to consumers who intend to purchase vehicles in other classes. This recommendation (i.e. providing specific emissions profiles on all vehicles) is consistent with previous studies which also find that Type I labels are typically less effective than Type III labels that provide information regarding specific environmental attributes.

Although the results of this study clearly indicate that consumers consider emissions information, we must further consider the differing reactions to this information before continuing on to ponder how these emissions profiles should be disseminated to a target audience. The first question to be deliberated is why global warming scores are significant in consumer decisions, while criteria pollutant information is mostly insignificant. Possible rationalization for

consumers' unilateral reaction to the global warming scores but heterogeneous reaction to the criteria pollutant scores must also be considered.

One possible explanation for the significant response of consumers to global warming scores is the prevalence of global warming information in the media, with specific emphasis on the ties to vehicle pollution. Global warming trends are frequently discussed in the media particularly with respect to the prominent Kyoto Protocol. These reports often include information on the link between large vehicles and increased greenhouse gas emissions, as well as subsequent global climate trends. As discussed in the results section, SUV's in particular have received a considerable amount of negative press with respect to their emissions profiles. Thus a consumer's stock of prior knowledge with respect to global warming pollutants, the link to vehicles and affect on the environment may be fairly similar across consumers. This comparable level of consumer knowledge may account for the significant reaction of consumers to global warming information. The media has provided all consumers with the tools needed to process information presented on global warming pollutants.

With respect to the homogeneity of consumer responses to global warming, literature regarding information dissemination in the field of food technology may provide some important insights. A 2002 study by Fox and his colleagues investigated the simultaneous presentation of conflicting information regarding irradiating food to control pathogens to determine how this information may affect revealed preferences (Fox, et. al., 2002). Their results suggest that when positive and negative information regarding the process was presented to

participants, the negative information dominated consumer's decisions. Their results may be applied to the current study in explaining the homogeneous reaction of survey participants to global warming information. The media, as previously mentioned, has reported extensively on the issues surrounding global warming; both positive and negative reports regarding the cause and effects of global warming have been reported. Fox's study suggests that consumers in the current study may be universally responding to the negative information regarding the cause and effects of global warming, where vehicles cause global warming gases and the effects include global flooding and climate change. Additionally, this negative information domination is consistent with a number of theories regarding consumer response to risk including loss aversion and reference risk effects. These two theories indicate that consumers magnify changes in risk, or monetary losses (Fox et. al., 2002). Thus survey participants in this study may be reacting to the risks associated with increased global warming gas emissions. Collectively the factors noted above would tend to homogenize the reactions of consumers to global warming information on emission profiles.

In contrast to the above global warming state, the empirical modeling results indicate that consumers have mostly insignificant and heterogeneous reactions to criteria pollutant information. There are a number of possible explanations for this result. First, this suggests that consumers may have different stocks of prior knowledge with respect to criteria pollutants which may explain the heterogeneous reactions. In contrast to the considerable amount of media attention paid to global warming pollutants, media reports regarding criteria

pollutants are generally few and far between with minimal emphasis on the relationship between vehicles and criteria pollutants. Additionally, the results may be picking up consumer dependence on regulatory agencies with respect to pollution control, which may explain the insignificance of the criteria information in the purchase decision. It is common knowledge that the United States has not yet ratified the Kyoto Protocol, the primary international document for curbing global warming gases. However, many American citizens would also be aware of the fact that criteria pollutants have been regulated in the United States since the initial draft in 1970 of the Clean Air Act. Consumers may be operating under the assumption that regulated pollutants are of less concern because the government has already taken steps to protect citizens from this pollutant, and thus consumers need take no further individual action. Perhaps the long-term efforts of the Environmental Protection Agency to establish and enforce national ambient air quality standards for criteria pollutants have left consumers less concerned with criteria air pollutants and operating under the assumption that a regulated pollutant is a 'less critical' pollutant. The insignificant reaction to criteria pollutants may be preliminary evidence that consumers consider regulated, labeled pollutants to be of lesser importance when making individual decisions.

An additional explanation for the differing reactions to global warming and criteria pollutant information may be the ability of consumers to link these explicit pollutant types to particular vehicle attributes. Global warming emissions are generally tied to the miles per gallon that a vehicle receives. Miles per gallon is a familiar attribute of the vehicle, and it may be easier for consumers to relate

unknown global warming emissions information to a familiar attribute. However, criteria pollutants are typically linked to the emissions control technology of each vehicle. This technology may be unfamiliar to consumers and thus understanding that criteria emissions scores result from this unfamiliar attribute may make it cognitively more difficult for consumers to consider criteria pollutants in the purchase decision.

A universal consumer response to global warming scores coupled with a heterogeneous response to criteria pollutant scores yields interesting policy ramifications. First, if consumers are more responsive to information regarding global warming gases due to media attention and the ability to link these scores to a particular vehicle attribute, this indicates that marketing efforts to familiarize consumers with the health and environmental consequences (short and long term) of vehicle emissions as well as the vehicle attributes that generate differing emissions profiles is an essential part of any policy program. If criteria pollutants have 'fallen off' consumers' radars due to regulation efforts, policy makers may consider providing additional information to consumers about local ambient air quality standards and non-attainment zones. Perhaps if Maine consumers were provided with the information that eight of the sixteen counties violated National Ambient Air Quality standards for the criteria pollutant of ozone last summer, they would be more responsive to emissions profiles that contained criteria information (ME DEP, 2004).

Now that we have identified a preferred mode of distributing the emissions information for passenger vehicles, and considered differing reactions

to the information we must now consider how the results may assist policy makers in targeting receptive consumers. A general profile of the environmentally concerned vehicle buyer is unavailable. This lack of comprehensive profile is consistent with previous studies by Balderjahn (1998).

Of particular importance, policy makers may be able to utilize the results of this analysis to influence perceptions relevant to the purchase decision. Linear hypothesis testing revealed that criteria emission profiles were significant in the purchase decision of individuals who perceive own consumer effectiveness (i.e. high PCE), perceive that other consumers may be taking action (i.e. high FIO), feel that eco-labeled vehicles are apt substitutes, are concerned with Maine air pollution and recognize the link between larger vehicles and poorer emissions records. These results yield an important policy implication: consumer perceptions matter in the vehicle purchase decision. Policy makers may be able to influence these pre-conceived perceptions with the educational component of eco-marketing campaigns. Mainer's currently hold erroneous perceptions of eco-labeled vehicles, where 56% of the survey sample perceived that eco-labeled vehicles would be more expensive and 35% of the sample felt that eco-labeled vehicles achieve lower performance. Additionally, 60% of the sample indicated that all vehicle classes pollute the same. As these perceptions, of eco-labeled vehicles and air quality concerns coupled with consumer assessment of their own and other's effectiveness, affect the purchase decision there is a clear directive for policy makers to incorporate educational components into future eco-labeling efforts. Given that a consumer's individual perceptions affect his/her reaction to

criteria pollutant information, it is clearly important to ensure that consumer's are operating with correct perceptions.

An important question yet to be addressed is who the education initiatives target? We must focus on two characteristics of a consumers to make this determination: a) rather or not a consumer has 'green' tendencies and b) do they possess knowledge regarding the link between vehicle emissions and air quality? Consumers who have no green tendencies, even if they obtained knowledge regarding vehicle emissions are not likely to act on this knowledge. In contrast, greens who are emissions knowledgeable presumably are already making purchase decisions commiserate with their green tendencies. Thus the target audience for eco-marketing educational campaigns must be greens who currently have limited or no knowledge regarding vehicle emissions and subsequent air quality effects.

The discussions of this chapter have identified a number of key policy implications resulting from the current analysis that must be synthesized into a comprehensive set of policy recommendations. First, policy makers in Maine must recognize that the current Clean Car eco-seal program may not be the best means of facilitating a match between consumer desire for environmentally preferred vehicles and such vehicles. The results indicate that consumers will consider specific information regarding a vehicles emission profile at the vehicle level, whereas the current system does not allow for such comparison of vehicles within a class. Given that consumers react differently to diverse pollutants, it is also important to provide specific emissions information to best facilitate the

decision-making process. Second, policy makers must recognize that while consumers universally react to global warming scores a consumer's reaction to criteria scores is dependant upon pre-conceived perceptions. Future eco-labeling initiatives should include a comprehensive education component where consumers are provided information on: a) the health and environmental consequences of criteria pollutants as an effort to include criteria pollutants in the purchase decision, b) the performance and price of eco-labeled vehicles in an effort to depict these vehicles as apt substitutes, c) the role consumers may play in changing the vehicle market and d) the extent of the current air quality degradation in Maine due to vehicle emissions. These pre-conceived perceptions are clearly important factors in a consumer's assessment of environmental information. The results of this study suggest that the actions recommended above can enhance Maine's current eco-labeling initiative

The analysis presented herein clearly contains a number of valuable insights into consumer purchase decisions for eco-labeled passenger vehicles. However, as with any study, especially one rushing headlong into previously uninvestigated economic avenues, there is always more work to be done. This final discussion section will outline directions for future research in the area of consumer assessment of traditional fueled passenger vehicles including suggestions for future analysis in other states and/or nationwide.

The above analysis is limited in its applicability given the exclusive focus on the state of Maine. In order to examine the convergent validity of these results, the generated estimates must be compared to results from similar studies.

Given that this study is the first of it's kind, future studies in this field would be extremely beneficial to policy makers as they evaluate the possibility of implementing eco-labeling initiatives. Future studies should consider implementing a similar survey instrument in other states, or perhaps even nationwide as a means of providing additional, accurate information to policy makers. Naturally these studies will need to pre-test the survey instrument to determine its appropriateness for use in adjoining states. The analysis contained herein has laid a firm foundation for additional studies to build upon in an effort to inform policy makers of the role that eco-labels may play in the traditional fuel market.

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APPENDICES

Appendix A

Complete Survey

Section I

Thank you for agreeing to fill out this survey. In this section, we want to know about your general opinions of Maine's air quality.

1. How concerned are you about the amount of air pollution in Maine? (PLEASE CIRCLE **ONE** NUMBER)

1	2	3	4	5
NOT AT ALL CONCERNED		SOMEWHAT CONCERNED		VERY CONCERNED

2. How would you rate Maine's air quality? (PLEASE CIRCLE **ONE** NUMBER)

1	2	3	4	5
VERY BAD		FAIR		VERY GOOD

3. **In your opinion**, what percent of Maine's air pollution is from people in Maine driving personal vehicles (do not include pollution from large commercial haulers, semi-trailers and buses)? (PLEASE FILL IN THE BLANK)

_____ PERCENT

4. **In your opinion**, which of the following types of vehicles make the most pollution when driven? (PLEASE CHECK **ONE** BOX)

- ❑ CARS
- ❑ STATION WAGONS/ MINI-VANS
- ❑ SPORT UTILITY VEHICLES (SUVs)
- ❑ PICKUP TRUCKS
- ❑ ALL PERSONAL VEHICLES POLLUTE ABOUT THE SAME

Section II

In this section, we want to know your views about environmental protection.

5. Please read the following statements. Please express **your opinion** by CIRCLING the answer that matches how you feel about the statement. (CIRCLE **ONE** NUMBER FOR **EACH** ITEM)

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEUTRAL	SOMEWHAT AGREE	STRONGLY AGREE

SCIENCE WILL BE ABLE TO SOLVE OUR ENVIRONMENTAL PROBLEMS

1 2 3 4 5

IT IS TOO HARD FOR SOMEONE LIKE ME TO DO MUCH ABOUT THE ENVIRONMENT

1 2 3 4 5

MOST PEOPLE DO THEIR PART TO PROTECT THE ENVIRONMENT

1 2 3 4 5

VEHICLES THAT PRODUCE LESS POLLUTION PROBABLY HAVE LOWER PERFORMANCE

1 2 3 4 5

STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEUTRAL	SOMEWHAT AGREE	STRONGLY AGREE

MY LIFESTYLE CAN HAVE AN IMPACT ON THE ENVIRONMENT

1 2 3 4 5

AIR POLLUTION LAWS ARE ALREADY STRONG ENOUGH

1 2 3 4 5

VEHICLES THAT PRODUCE LESS POLLUTION ARE PROBABLY MORE EXPENSIVE

1 2 3 4 5

I TRUST THE STATE GOVERNMENT TO PROTECT MAINE'S ENVIRONMENT

1 2 3 4 5

MOST PEOPLE ARE WILLING TO PAY HIGHER PRICES TO PROTECT THE ENVIRONMENT

1 2 3 4 5

Section III

In this section, we want to know about the vehicle you drive most often.

6. When did you buy or lease the vehicle you drive most often? (PLEASE CHECK **ONE** BOX)

- ❑ DURING THE LAST YEAR
- ❑ DURING THE LAST 2-3 YEARS
- ❑ DURING THE LAST 4-6 YEARS
- ❑ MORE THAN 7 YEARS AGO

7. Was this a new vehicle when you bought or leased it? (PLEASE CHECK **ONE** BOX)

- ❑ YES
- ❑ NO

8. Did you buy or lease this vehicle from a dealer in Maine? (PLEASE CHECK **ONE** BOX)

- ❑ YES
- ❑ NO

9. What type of vehicle is it? (PLEASE CHECK **ONE** BOX)

- ❑ CAR
- ❑ STATION WAGON/ MINI-VAN
- ❑ SPORT UTILITY VEHICLE (SUV)
- ❑ PICKUP TRUCK

10. About how many miles do you drive this vehicle? (PLEASE FILL IN **ONE** OF THE BLANKS)

_____ MILES PER WEEK **OR** _____ MILES PER YEAR

11. Assume you were going to replace your current vehicle. What type of vehicle would your new vehicle be? (PLEASE CHECK **ONE** BOX)

- ❑ CAR
- ❑ STATION WAGON/ MINI-VAN
- ❑ SPORT UTILITY VEHICLE (SUV)
- ❑ PICKUP TRUCK

12. When people buy a new vehicle they often make their choice based upon how the vehicle will be used most often. Please rate how important each of the following uses would be to you. (PLEASE CIRCLE **ONE** NUMBER FOR **EACH** ITEM)

NOT AT ALL IMPORTANT		SOMEWHAT IMPORTANT		VERY IMPORTANT
COMMUTING TO WORK				
1	2	3	4	5
FOR RECREATIONAL PURPOSES (EX: HAULING A BOAT OR SNOWMOBILE)				
1	2	3	4	5
TO TRANSPORT MY FAMILY				
1	2	3	4	5
USES RELATED TO MY JOB (EX: HAULING TOOLS)				
1	2	3	4	5
OTHER (PLEASE LIST_____)				
1	2	3	4	5

Section IV

In this section, we want to know the type of environmental information available to vehicle buyers.

13. Before buying or leasing a new vehicle, do you search for information about how much pollution the vehicle produces when driven? (PLEASE CHECK **ONE** BOX)

- ❑ YES
- ❑ NO => SKIP TO QUESTION 15

14. Where do you search for this information? (PLEASE CHECK **ALL** THAT APPLY)

- ❑ MANUFACTURERS' WEBSITES
- ❑ U.S. ENVIRONMENTAL PROTECTION AGENCY'S WEBSITE
- ❑ MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION
- ❑ AUTO DEALERS
- ❑ NEWSPAPERS
- ❑ CONSUMER REPORTS
- ❑ RADIO OR T.V. ADS
- ❑ ENVIRONMENTAL ORGANIZATION (PLEASE SPECIFY) _____
- ❑ OTHER (PLEASE SPECIFY) _____

15. Would you like information that helps you identify which vehicles produce less pollution when driven? (PLEASE CHECK **ONE** ANSWER)

- ❑ YES
- ❑ NO

16. Have you visited a new car/truck dealer in Maine during the last 12 months? (PLEASE CHECK **ONE** BOX)

- ❑ YES
- ❑ NO

17. **In your experience,** are auto dealers helpful in giving you information about how much air pollution a vehicle makes? (PLEASE CHECK **ONE** BOX)

- ❑ YES
- ❑ NO

Section V

In this section, we want to know your responses to different eco-labels for cars and trucks.

Please read the following before continuing the survey.

The State of Maine has begun eco-labeling all new vehicles sold in the state. A vehicle will display an eco-label **if** the vehicle meets Maine air pollution standards and gets more than 30 miles per gallon. This information is available from manufacturers, does not require any emissions testing and does not raise vehicle prices.

18. Have you seen these eco-labels (see below) on any vehicles? (PLEASE CHECK **ONE** BOX)

- ❑ YES
- ❑ NO

19. How important is this type of information to you? (PLEASE CIRCLE **ONE** NUMBER)

1	2	3	4	5
NOT AT ALL IMPORTANT		SOMEWHAT IMPORTANT		VERY IMPORTANT

20. There are different pieces of information that could be part of a vehicle's eco-label. Please review the following list and rate how important each piece of information is to you. (PLEASE CIRCLE **ONE** NUMBER FOR **EACH** ITEM)

	NOT AT ALL IMPORTANT		SOMEWHAT IMPORTANT		VERY IMPORTANT
INFORMATION ABOUT WHO IS CERTIFYING THE LABEL	1	2	3	4	5
A LISTING OF THE POLLUTANTS THAT THE VEHICLE EMITS	1	2	3	4	5
INFORMATION ABOUT HOW MUCH OF EACH POLLUTANT THE VEHICLE EMITS	1	2	3	4	5
INFORMATION COMPARING A VEHICLE'S POLLUTION LEVEL TO THE AVERAGE POLLUTION LEVEL FOR ALL OTHER PERSONAL VEHICLES (EX: INFORMATION TO COMPARE AN SUV TO ALL OTHER PERSONAL VEHICLES)	1	2	3	4	5
INFORMATION COMPARING A VEHICLE'S POLLUTION LEVEL TO THE AVERAGE POLLUTION LEVEL FOR PERSONAL VEHICLES IN THE SAME VEHICLE CATEGORY (EX: INFORMATION TO COMPARE AN SUV TO ALL OTHER SUVS)	1	2	3	4	5

21. Please review the following hypothetical eco-label and answer the following questions.

How much do you trust this label? (PLEASE CIRCLE **ONE** NUMBER)

1	2	3	4	5
DO NOT TRUST		SOMEWHAT TRUST		HIGHLY TRUST

In your opinion, how eco-friendly is this vehicle? (PLEASE CIRCLE **ONE** NUMBER)

1	2	3	4	5
NOT ECO-FRIENDLY		SOMEWHAT ECO-FRIENDLY		VERY ECO-FRIENDLY

How much information does this label provide you? (PLEASE CIRCLE **ONE** NUMBER ANSWER)

1	2	3	4	5
NOT ENOUGH INFORMATION		JUST ENOUGH INFORMATION		TOO MUCH INFORMATION

How important is this information to you. (PLEASE CIRCLE **ONE** NUMBER)

1	2	3	4	5
NOT AT ALL IMPORTANT		SOMEWHAT IMPORTANT		VERY IMPORTANT

Would seeing this label on a vehicle make you more or less likely to buy it when compared to a similar unlabeled vehicle? (PLEASE CIRCLE **ONE** NUMBER)

1	2	3	4	5
HIGHLY UNLIKELY		NO OPINION EITHER WAY		HIGHLY LIKELY

Section VI

In this section, you are to imagine that you are at an auto dealer looking to buy a vehicle. You will be asked to identify which vehicle you would buy.

Please read the following before continuing the survey.

Maine's air violates health standards in southern coastal counties and Acadia National Park. Passenger vehicles are the major source of air pollution in Maine.
Vehicles differ in how much air pollution they produce.

- There are two types of air pollutants produced by vehicles: criteria pollutants and global warming gases.
- The amount of criteria pollutants produced is mainly related to a vehicle's pollution control technology.
- The amount of global warming gases produced is mainly related to a vehicle's gas mileage.

Below is a description of the air pollutants produced by vehicles

Criteria Pollutants
* Can form smog and leads to the formation of acid rain. Acid rain can damage or kill forests and fish habitats.
* Smog can reduce visibility, aggrevate asthma and cause coughing and difficult or painful breathing. Repeated exposure may cause lung damage.

Global Warming Gases
* These gases will trap the earth's heat and may change Maine's climate. For example, sea levels may rise and lead to flooding.
* Climate changes could increase the number of heat-related illnesses and deaths.

22. Assume the State has developed an air pollution rating system where all new vehicles are rated on a scale of 1-10. A higher score indicates the vehicle is better for the environment (produces less air pollution). Below are several types of vehicles and information about the average price, gas mileage and air pollution scores for each vehicle type.

	Cars	Station wagons/ Mini-vans	Sport Utility Vehicles	Pickup Trucks
Average price	$21,750	$21,880	$27,330	$20,250
Miles per gallon	30	21	20	17
Air pollution scores (0 = Dirtiest, 10 = Cleanest)				
Criteria pollutants	3	3	2	1
Global warming gases	7	5	3	4

Given the above information, which type of vehicle would you purchase?
(PLEASE CHECK **ONE** ANSWER AND THEN SKIP TO THE INDICATED QUESTION)

- ❑ CAR => SKIP TO QUESTION 23 PAGE 14
- ❑ STATION WAGON/ MINI-VAN => SKIP TO QUESTION 26 PAGE 15
- ❑ SPORT UTILITY VEHICLE (SUV) => SKIP TO QUESTION 29 PAGE 16
- ❑ PICKUP TRUCK => SKIP TO QUESTION 32 PAGE 17

23. Now assume you find three **cars** that are exactly the same except for the information presented below. Given this information which would you choose? (PLEASE CHECK **ONE** BOX)

- ❑ CAR - X => SKIP TO SECTION VII
- ❑ CAR - Y => SKIP TO SECTION VII
- ❑ CAR - Z => SKIP TO SECTION VII
- ❑ I WOULD NOT CHOOSE ANY OF THESE

	CAR X	**CAR Y**	**CAR Z**
Price	$22,550	$21,750	$21,350
Miles per gallon	37	30	26
Air pollution scores (0 = Dirtiest, 10 = Cleanest)			
Criteria pollutants	6	3	0
Global warming gases	10	7	5

24. Why did you choose not to buy one of the above **cars**? (PLEASE CHECK **ONE** BOX)

- ❑ THE PRICES ARE TOO HIGH (OUT OF MY PRICE RANGE)
- ❑ THE MILES PER GALLON ARE TOO LOW
- ❑ THE CRITERIA POLLUTANT SCORES ARE TOO LOW
- ❑ THE GLOBAL WARMING GASES SCORES ARE TOO LOW

25. Instead of buying one of the above **cars**, what would you do? (PLEASE CHECK **ONE** BOX)

- ❑ NOT BUY ANY VEHICLE
- ❑ SWITCH TO THE **STATION WAGON/ MINI-VAN** CATEGORY
- ❑ SWITCH TO THE **SPORT UTILITY VEHICLE** CATEGORY
- ❑ SWITCH TO THE **PICKUP TRUCK** CATEGORY

PLEASE CONTINUE TO SECTION VII (PAGE 18)

26. Now assume you find three identical **station wagon/mini-vans** that are exactly the same except for the information presented below. Given this information which would you choose? (PLEASE CHECK **ONE** BOX)

- ❑ WAGON/MINI-VAN - X => SKIP TO SECTION VII
- ❑ WAGON/MINI-VAN - Y => SKIP TO SECTION VII
- ❑ WAGON/MINI-VAN - Z => SKIP TO SECTION VII
- ❑ I WOULD NOT CHOOSE ANY OF THESE

	WAGON/ VAN X	**WAGON/ VAN Y**	**WAGON/ VAN Z**
Price	$22,280	$21,880	$19,880
Miles per gallon	25	21	15
Air pollution scores (0 = Dirtiest, 10 = Cleanest)			
Criteria pollutants	4	3	0
Global warming gases	9	5	2

27. Why did you choose not to buy one of the above **station wagon/mini-vans**? (PLEASE CHECK **ONE** BOX)

- ❑ THE PRICES ARE TOO HIGH (OUT OF MY PRICE RANGE)
- ❑ THE MILES PER GALLON ARE TOO LOW
- ❑ THE CRITERIA POLLUTANT SCORES ARE TOO LOW
- ❑ THE GLOBAL WARMING GASES SCORES ARE TOO LOW

28. Instead of buying one of the above **station wagon/mini-vans**, what would you do? (PLEASE CHECK **ONE** BOX)

- ❑ NOT BUY ANY VEHICLE
- ❑ SWITCH TO THE **CAR** CATEGORY
- ❑ SWITCH TO THE **SPORT UTILITY VEHICLE** CATEGORY
- ❑ SWITCH TO THE **PICKUP TRUCK** CATEGORY

PLEASE CONTINUE TO SECTION VII (PAGE 18)

29. Now assume you find three **sport utility vehicles (SUVs)** that are exactly the same except for the information presented below. Given this information which would you choose? (PLEASE CHECK **ONE** BOX)

- ❑ SUV - X => SKIP TO SECTION VII
- ❑ SUV - Y => SKIP TO SECTION VII
- ❑ SUV - Z => SKIP TO SECTION VII
- ❑ I WOULD NOT CHOOSE ANY OF THESE

	SUV X	**SUV Y**	**SUV Z**
Price	$27,430	$27,330	$26,530
Miles per gallon	29	20	16
Air pollution scores (0 = Dirtiest, 10 = Cleanest)			
Criteria pollutants	6	2	1
Global warming gases	8	3	1

30. Why did you choose not to buy one of the above **SUVs**? (PLEASE CHECK **ONE** BOX)

- ❑ THE PRICES ARE TOO HIGH (OUT OF MY PRICE RANGE)
- ❑ THE MILES PER GALLON ARE TOO LOW
- ❑ THE CRITERIA POLLUTANT SCORES ARE TOO LOW
- ❑ THE GLOBAL WARMING GASES SCORES ARE TOO LOW

31. Instead of buying one of the above **SUVs**, what would you do? (PLEASE CHECK **ONE** BOX)

- ❑ NOT BUY ANY VEHICLE
- ❑ SWITCH TO THE **CAR** CATEGORY
- ❑ SWITCH TO THE **STATION WAGON/ MINI-VAN** CATEGORY
- ❑ SWITCH TO THE **PICKUP TRUCK** CATEGORY

PLEASE CONTINUE TO SECTION VII (PAGE 18)

32. Now assume you find three identical **pickup trucks** that are exactly the same except for the information presented below. Given this information which would you choose? (PLEASE CHECK **ONE** BOX)

- ❑ TRUCK - X => SKIP TO SECTION VII
- ❑ TRUCK - Y => SKIP TO SECTION VII
- ❑ TRUCK - Z => SKIP TO SECTION VII
- ❑ I WOULD NOT CHOOSE ANY OF THESE

	TRUCK X	**TRUCK Y**	**TRUCK Z**
Price	$20,600	$20,250	$19,900
Miles per gallon	23	17	13
Air pollution scores (0 = Dirtiest, 10 = Cleanest)			
Criteria pollutants	2	1	0
Global warming gases	6	4	3

33. Why did you choose not to buy one of the above **pickup trucks**? (PLEASE CHECK **ONE** BOX)

- ❑ THE PRICES ARE TOO HIGH (OUT OF MY PRICE RANGE)
- ❑ THE MILES PER GALLON ARE TOO LOW
- ❑ THE CRITERIA POLLUTANT SCORES ARE TOO LOW
- ❑ THE GLOBAL WARMING GASES SCORES ARE TOO LOW

34. Instead of buying one of the above **pickup trucks**, what would you do? (PLEASE CHECK **ONE** BOX)

- ❑ NOT BUY ANY VEHICLE
- ❑ SWITCH TO THE **CAR** CATEGORY
- ❑ SWITCH TO THE **STATION WAGON/ MINI-VAN** CATEGORY
- ❑ SWITCH TO THE **SPORT UTILITY VEHICLE** CATEGORY

PLEASE CONTINUE TO SECTION VII (PAGE 18)

Section VII

In this section, we would like to know a little bit about you for comparison purposes. Please remember that all of your answers are strictly confidential. However, we need this information to be able to compare your responses to other Mainers.

35. What is your gender? (PLEASE CHECK **ONE** BOX)

- ❑ MALE
- ❑ FEMALE

36. What is your race/ethnicity? (PLEASE CHECK **ALL** THAT APPLY)

- ❑ WHITE
- ❑ BLACK
- ❑ HISPANIC OR OF SPANISH ORIGIN
- ❑ ASIAN OR PACIFIC ISLANDER
- ❑ AMERICAN INDIAN OR ALASKAN NATIVE
- ❑ OTHER, (PLEASE SPECIFY)_____

37. How old are you? (PLEASE FILL IN THE BLANK) _____

38. What is the highest level of education you have completed? (PLEASE CHECK **ONE** BOX)

- ❑ 0-11 YEARS
- ❑ 12 YEARS (HIGH SCHOOL DIPLOMA OR GED)
- ❑ SOME COLLEGE
- ❑ COLLEGE GRADUATE (BACHELOR'S DEGREE OR EQUIVALENT)
- ❑ POSTGRADUATE, MASTERS DEGREE, DOCTORATE, LAW DEGREE, OTHER PROFESSIONAL DEGREE

39. Please indicate if you participated in any of the following outdoor recreation activities during the last YEAR (PLEASE CHECK **ALL** THAT APPLY)

- ❑ HIKING
- ❑ BICYCLING/MOUNTAIN-BIKING
- ❑ WILDLIFE WATCHING
- ❑ CAMPING
- ❑ SNOWMOBILING
- ❑ NATURE PHOTOGRAPHY
- ❑ SAILING/BOATING/CANOEING
- ❑ HUNTING
- ❑ ATV/DIRT BIKING
- ❑ OTHER (PLEASE SPECIFY)_____
- ❑ I DO NOT PARTICIPATE IN OUTDOOR RECREATION ACTIVITIES

40. Do you belong to, work for, or contribute to any environmental groups? (PLEASE CHECK **ONE** BOX)

- ❑ YES (PLEASE SPECIFY) _____
- ❑ NO

41. What was your total household income before taxes last year? (PLEASE CHECK **ONE** BOX)

- ❑ LESS THAN $10,000
- ❑ $10,000 -$19,999
- ❑ $20,000-$29,999
- ❑ $30,000-$39,999
- ❑ $40,000-$49,999
- ❑ $50,000-$59,999
- ❑ $60,000-$69,999
- ❑ $70,000-$79,999
- ❑ $80,000-$90,000
- ❑ MORE THAN $90,000

THANK YOU FOR YOUR HELP!

Please return the completed survey in the postage paid, self-addressed envelope:

University of Maine – Car and Truck Survey
Department of Resource Economics & Policy
Winslow Hall
Orono, ME 04469

Survey 3

Appendix B

Versions of Eco-Labels

Figure B1. Base Case.

Figure B2. Sliding Scale Comparison to Average of All Vehicles in Class.

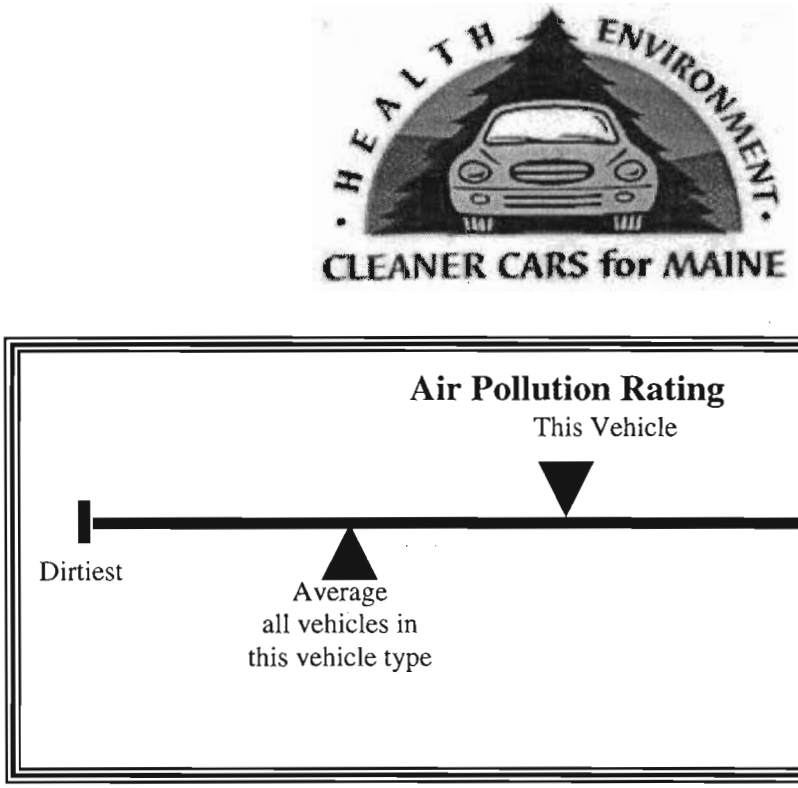


Figure B3. Sliding Scale Comparison to Average for All Personal Vehicles.

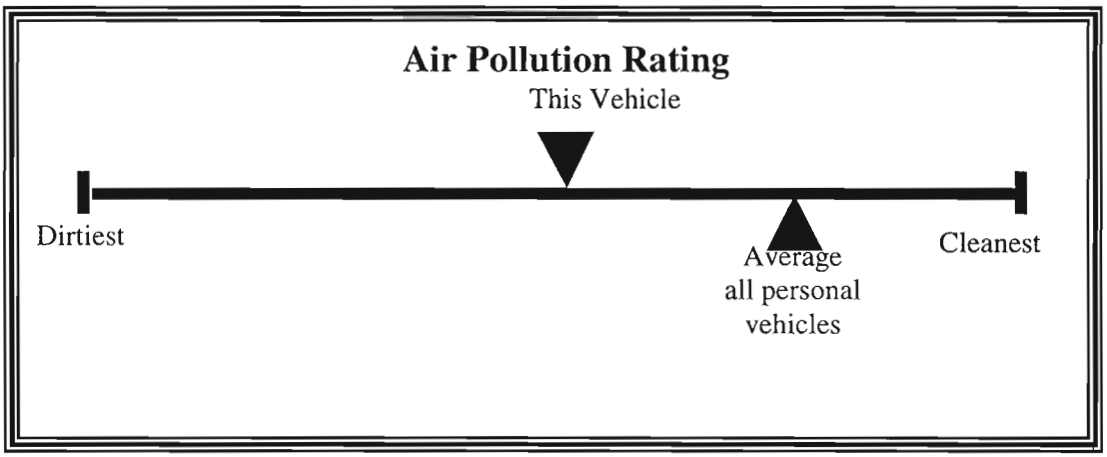


Figure B4. Thermometer Scale Comparing to Average of All Personal Vehicles.

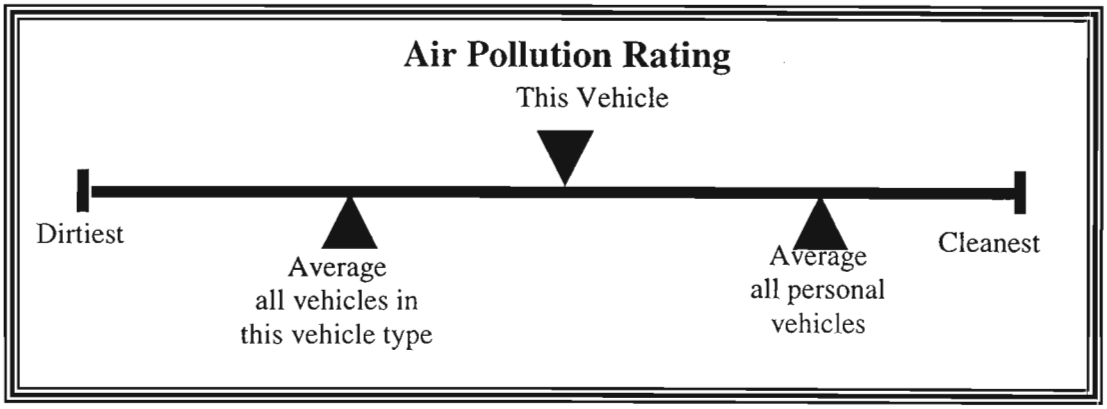
Air Pollution Rating

This Vehicle

Average all personal vehicles

Dirtiest Cleanest

Figure B5. Sliding Scale Comparison to All Other Personal Vehicles and Vehicles in Class.



BIOGRAPHY OF THE AUTHOR

Caroline Lundquist Noblet is a Maine native, born May 16, 1977 in Bangor, Maine. She is a graduate of Gardiner Area High School (class of 1995). She attended Boston College where she received a Bachelor's degree in Economics and Environmental Studies in 1999. After working at Boston's largest law firm for two years, and marrying Michael Noblet in 2000, Caroline became a high school science teacher for two years in Weymouth, MA.

Caroline entered the graduate program of the Resource Economics and Policy Department at the University of Maine in September of 2003. She is a candidate for the Master of Science degree in Resource Economics and Policy from The University of Maine in August, 2005.