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Revealing Demand for Nature Experience Using Purchase Data of Equipment and Lodging

Abstract:
In 1967, John Krutilla suggested a relationship between car camping, canoe cruising, and cross-country skiing and induced demand for wild, primitive, and wilderness-related opportunities. Here, the time trend of cross-section parameter estimates of the relationship is examined. Households produce nature experiences using two factors: nature attributes and tools. Tools are equipment and lodging. While many studies have investigated to-site costs of producing nature experiences, on-site costs such as equipment and lodging are studied here by using Consumer Expenditure Survey data for Norway. Income coefficients of household demand for nature services in independent cross-section samples for each year are estimated over the period 1986-95. Proportions of households with non-zero purchase expenditures for equipment are followed from 1975 to 1995. Similar proportions of lodging expenditures are studied from 1986 to 1995. Out of a total of 526 goods in an exhaustive system, 20 goods are singled out and classified as nature experience tools. Two additional non-good expenses are added. Coefficients of demand are estimated for each year by using a tobit structure and a maximum likelihood procedure. While income coefficients of equipment and lodging are quite stable, household size coefficients are not. Both equipment and lodging remain luxury items over the period 1986-1995. Proportions of households with positive purchase expenditure on tools increase over time: In a referendum-by-wallets, nature experience production has received more votes and become more popular.

Keywords: Consumption pattern, environmental valuation, experience production, demand for nature services, willingness-to-pay

JEL classification: C21, C24, D11, D12, D13, Q21, Q26

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1. Introduction

People fear that humankind is destroying nature and that opportunities of nature experiences are eroding. While modern society produces an increasing number of inventions for supplying its citizens with goods, there is one good that appears to be in limited supply: Nature service. Planet Earth is a commons, and the services it renders are affected by numbers of users. Supply of services are bound by the size of the globe. At the same time, demand for nature services seem to be on the increase. Here, attention is focused on demand.

Americans hike up Half Dome in Yosemite, ski down Mount Rainier nearby Seattle, raft the Colorado River through the Grand Canyon, and camp in Yellowstone. Europeans hike the Pyreenees, ski the Alps, sail the Mediterranean, and cross Norwegian glaciers. All over the world, people partake in outdoor life for recreational purposes. They ski across Greenland, sail the Atlantic Ocean, and climb Mount Everest. Back-packers travel to the exotic beaches of Kho Phi Phi to swim in emerald green waters. Surfers flock to Australia to ride azure blue waves. Kayakers paddle downstream Sjoa to engage in whitewater froth. The list goes on and on, and constitutes overwhelming anecdotal evidence for an increase in number of people looking for the wild edges of nature. Demand for nature services appears to be increasing. Is it? We locate a suitable data set for empirical scrutiny of the time component of demand for nature services and investigate properly specified questions.

Already in 1967, John Krutilla [24] (p. 782) predicted that people would demand more services of nature in the future:

> Given the phenomenal rise of car camping, if this activity will spawn a disproportionate number of future back-packers, canoe cruisers, cross-country skiers, etc., the greater will be the induced demand for wild, primitive, and wilderness-related opportunities for indulging such interest. Admittedly, we know little about the demand for outdoor experiences which depend on unique phenomena of nature - its formation, stability, and probable course of development. These are important questions for research, results of which will have significant policy implications.

A main target of our investigation is the luxury status of the nature experiences Krutilla mentioned. A hundred years ago, only the richest of the rich in Europe could afford crossing the Atlantic and traveling by train to Banff, a remote town in the Canadian Rockies. Such a trip was a luxury, and purchasing it spectacularly conspicuous. Much cheaper goods were luxuries too. An ordinary worker could hardly afford the time nor the money cost of sailing, climbing or camping, let alone doing it on a regular basis. Today, prices and budgets are different. How much of a luxury is outdoor experiences for recreational purposes today? Another question is the ubiquity of usage of nature services. Does overall taste for it vary over time? I attempt to illuminate the former by estimating cross-sectional income coefficients of demand at different points in time. The latter question is studied by tracking and comparing cross-sectional participation rates over time.

There are few directly observable markets for the purchase of nature experiences, an obstacle long acknowledged in the environmental valuation literature. In the profession, we conventionally resort to study non-market demand by observing related indirect markets. Here, my application of the method is to follow purchases of complements of nature services. In this study, I observe expenditures people accept on tools they need to produce outdoor experiences. For example, when people want to experience winter-park fun, they need skis and winter clothes. Such items are instrumental to enjoying and participating in snow-related activities. When people swim, they wear swim-suits. When they dive, they use wet-suits, masks, and frogman's feet.

To produce nature experiences, people acquire hiking shoes, tents, mountain bikes, backpacks, and sleeping bags. They need lodges, huts, and cabins to sleep in. Thus, although demand for nature may be latent people leave tracks not only in the woods but also in the stores as they empty their wallets. We study tracks left by the implicit demand for accessories. Put differently, we aim to detect the direction of the consumer's path in nature by investigating money-prints, in absence of footprints.

These money-prints are collected by the Norwegian Consumer Expenditure Survey (CES) in interviews and in acccount-books. I use CES data to estimate cross-sectional demand slopes for each year in the period 1986-1995 for one specifically defined, aggregate outdoor equipment good and one lodging good. Additionally, I study the time trend of the proportion in cross-section samples of households with positive purchases of outdoor equipment or lodging. Evidence suggests that outdoor equipment and lodging are luxuries, and remain luxuries over the period. Participation rates as measured by proportions of purchasing households have increased.

In the next section, we shall first study a pressing question: Are there data sets that allow studies of outdoor recreation preferences over time? Having resolved principal data issues, we pose specific questions in the following section. Then, I relate my method to the context of environmental valuation and give a brief review of relevant literature. In chapter five, I present the consumer theory of experience production. In chapter six, I describe data in detail and go through my estimation techniques. Subsequently, I devote one chapter to empirical regularities that emerge and another to inventory and discuss limitations of the study. There are, admittedly, puzzles, shortcomings, and unexplained observations. The last chapter contains conclusions and policy implications.

2. Essential Features of Data

A student of an empirical problem must make plausible that his or her choice of data set is suitable for the purpose of the investigation. Furthermore, the student must substantiate that interpretations are legitimate and warranted given data quality and theoretical assumptions. In environmental valuation, data are scarce. In the absence of markets, we examine circumstantial evidence, destill the information, and aquire sediments of knowledge. There is a tradition in environmental valuation for using indirect, implicitly accepted costs of an activity as indicators of willingness-to-pay. For example, if you take a week off and go fishing you have implicitly assumed costs in doing so. Studies of outlays and foregone income are the basis of the travel cost method (TC). Another approach is simply to ask a person what fishing is worth to her. For example, researchers could ask her to put a monetary value on how much she would be willing to pay for an electricity firm not piping a river. Or researchers could ask her what she would be willing to pay for cleaning it up should it become polluted. This tradition is called contingent valuation (CV).

TC and CV have not generated data sets well-suited to illuminate the time element in Krutilla's suggestion. How do preferences behave over time? In order to throw light on such a question it is crucial that we are able to compare estimates at different points in time. The obvious way to do it is to repeat in year t+s exactly what was done in year t and assess differences. That requires a consistent application of a specific method repeatedly over time. Thus, *time span* and *similarity over time* are criteria that must be satisfied. Third, the data and the corresponding method must reveal sufficient information to invite deductions and allow conclusions.

Criterion one and two concern data generation. The third criterion involves an interplay of data and method. Travel cost methods and contingent valuation methods score high on the third criterion, but have scored low on the first two so far. Studies have aimed at estimating a *level* at a given point in time, not *differences between levels* over a period. Here, we are interested in differences emerging as time trends and look for other data sets than those generated by TC and CV. Our first task is to discuss usage of a potentially suitable data set and device analytic tools to study it. Here, I propose using consumer expenditure survey data. Let us inspect the rationale for utilizing it.

Norwegian CES data are gathered by Statistics Norway every 26 two-week periods of the year. I study the period 1986-95 and 1975-95 in one substudy. Thus, there is span of time. Second, data are collected in the same fashion every two-week period year after year using a combination of questionnaires and interviews. Variables are the same. Sample selection algorithms are the same.[1] Thus, the similarity over time criterion is satisfied to a high degree.

Let us consider the third criterion: information content and revelation potential. CES data are acquired using an algorithm designed to ensure randomization. Therefore, samples are representative of the population. There are non-responding and defecting households, but statisticians have constructed non-response weights to realign sample attributes with population attributes. CES data contain purchase expenditure information on an exhaustive list of 526 goods covering all the ways households may have purchase outlays. Further, data contain information on a wide range of demographic and socioeconomic attributes of each household. Thus, CES data are rich in information on purchase behavior.

Do data also have the potential of illuminating the question at hand? I claim they do. CES data may reveal patterns of demand for nature-related goods and therefore, implicitly, for nature services. Recall the example above of a fishing trip. In order to fish, you do not only have to forego income and buy travel tickets (as are measured by TC). Additionally, you have to get equipment. You must find lodging. Those expenses are indirect, as are foregone income and travel costs, but unveil information on demand for nature services. The specific expenses we study here are tool costs (equipment) and on-site-costs (lodging). Consumer Expenditure Surveys register expenditure on equipment and lodging in a detailed manner so we are able to distinguish goods using a relatively fine grid and make well-argued choices of aggregation. I develop a simple theory of household production of nature experience. The theory is built upon the relationship between equipment and lodging purchases and nature services.

3. Questions Posed and Answers Offered

Concerned citizens suspect that economic growth will lead to environmental degradation. We will see that evidence from consumer behavior is not singularly negative. Data imply that households use nature in higher frequencies to produce experiences. CES data suggest that people participate in nature experience activities more often than before. Data indicate that consumers consider these activities to be luxury items. As such, the demand may increase further as society grows richer. Use of nature for recreational purposes entails concern over loss of natural attributes and nature opportunities. Demand for nature services may lead to demand for protection of nature and its qualities.

If outdoor experience is a luxury commodity, always and everywhere, then the direction of, if not the magnitude of, future demand is trivial: demand will rise with income and it will command a growing share of available resources, given prices and qualities. It is, however, an empirical question whether outdoor experience is considered by consumers to be luxurious, and if it remains a luxury over time. We do not know how changed circumstances will affect demand. Quality improvements of products, price reductions, introduction of substitutes and complements will affect demand. Education, cultural factors, and diffusion of knowledge about how to produce nature experiences influence preferences. A study of demand over time is warranted and may reveal surprising patterns. Weitzman [44] (p. 52) called for estimates of demand structures:

> ...the debate about future limits to growth is ultimately an empirical one. The outcome depends upon deep structural parameters and assumptions about human behavior. The cast of prominent characters is by now familiar: elasticities of substitution, factor augmenting technological change, population growth, stocks of natural resources, the income elasticity of environmental tastes, and so forth.

Here, we make the estimation of such elasticities one purpose of study.

[1] A slight modification of the algorithm was implemented in 1992.

In order to present interpretations of data we must narrow our scope. 'Is demand increasing?' is simply too broad a question to answer. I look for answers to specific question: Given our model and definition, is the income coefficient of demand for nature-related goods stable over time? Is there a time trend in coefficients of household demographic composition? Do outdoor equipment and lodging remain luxuries over the period? Does the the proportion of households with positive outlays on nature tools increase over time? Our data suggest answering 'yes' to all the questions.

4. Context and Literature

People speculate over the relationship between standards of living, consumption patterns and demand for environmental quality. In particular, one idea says thatnature service is a luxury good, with a budget share ascending with total consumption.[2] It is similar to stating that society is positioned south-east on an environmental Kuznets-curve[3]. Such curves have received much attention in the literature. In this study, I examine the relationship between income and production of nature experience on a micro basis. Confer with Grossman and Krueger [16], Hilton and Levinson [19], Selden and Song [38], and Kahn [21] for interesting perspectives on environmental Kuznets curves.

There are many ways to look for increased demand for nature services. From the stated preference approach, a contingent valuation method as first suggested by Ciriacy-Wantrup [9] could, at least in theory, be used. Contingent valuation is a suitable technique for assessing willingness-to-pay (WTP), see Hanemann [18]. If used repeatedly and consistently, CV would reveal time trends in valuation. Increased estimated WTP over time for individuals or constant WTP for individuals but increased number of individuals for a given site (or a specific feature of different sites) would warrant conclusions of increased demand. In order to reach such conclusions, CV generated data would have to span a time period, be comparable over time, and be sufficiently revealing. There seems to be a paucity in the literature for such comparisons over time.

From the indirect evidence approach, a travel cost (TC) method as described in Freeman [13] (pp. 443-483) could be utilized to detect time trends. The researcher would then employ a TC set-up repeatedly and ensure comparability between points in time. It would be costly. Prohibitive cost issues aside, self-selection problems of TC would also need to be resolved, as usual. It is a well-known problem that it is difficult to disentangle true costs when consumers most interested in a particular feature of nature might relocate and set up residence close to it. When asked, the consumer will then report only moderate travel costs, while a true account of costs should have included relocation expenses. Further, endogeneity of opportunity costs could be problematic if different over time.[4] CES data, on the other hand, are well-suited for longitudinal presentations of estimates of cross-sectional parameters. CES data are of high quality. Why is that? Generating CES data is an expensive undertaking. Data are generated partly because they serve other goals, considered very important. One such goal is the computation of weights for Consumer Price Indices (CPI). CPI is a core metric in economic policy and its frequent employment in policy-making ensures that generous amounts of resources go into data generation and control of data quality.

Bell and Leeworthy [5] pointed out that to participate in outdoor recreation tourists are faced with two cost sources: Travel and stay. Here, I point out a third: production. Production costs are connected to stay through lodging and to recreational activity through equipment and gear. In their study, Bell and Leeworthy examine on-site costs in what may be called an on-site-cost model. On-site costs should include equipment, but little attention in the travel cost literature has been focused on equipment. Attention should and could be focused on equipment and

[2] For constant prices and given qualities.

[3] An environmental Kuznets-curve is a U-relation between environmental quality and material standard of living.

[4] However, a consistent application of one method at different points in time could yield highly informative results on differences between levels even if the method got levels wrong.

lodging. To swim you need swimsuits, to play volleyball you need trunks and balls, and you need fishing equipment when you fish. Equipment is necessary to produce recreation out-of-doors. CES data represent a window into the consumer behavior behind acquisition of nature tools.

Hotelling [20] initiated the use of TC methods to assess environmental valuation through observation of implicitly assumed costs. Since, usage has spread and indirect methods have recently been applied to such diverse phenomena as demand for protected natural areas in Mallorca (Font [12]), ecotourism in Madagascar (Maille and Mendelsohn [28]), value of tropical rainforests in Costa Rica (Menkaus and Lober [32] and wildlife viewing (Navrud and Mungatana [35]). The prevalence of travel cost methods attests the usefulness of the idea that some costs are implicit, but necessary. These costs are parts of the total outlay and thus function as decision variables. The basic idea of this study is similar, so I operate within the well-establihsed framework of indirect valuation methods.

Research into TC methods have revealed several problems. Opportunity cost of leisure time is one often-cited complicating feature of travel cost methods. Traditionally, it is set to a fraction of a wage rate. Feather and Shaw [11] argue that time use is essential in recreation demand studies since time as often as money is the limiting factor. Oftentimes, you cannot trade money with time. They suggest a procedure involving stochastic wage and shadow wage function to obtain estimates of opportunity cost. This study discusses similar obstacles in CES data. If households spend time differently and substitute manual labor for instruments in producing nature experience, the model presented here inherits some of the time cost problem of TC.

Valuation is a main theme in environmental literature. One recent example is Leggett and Bockstael [27] who study the association between water quality and property values of waterfront residences using hedonic techniques. Tyrväinen and Miettinen [43] examine the link between property prices and urban forest characteristics. Relying on reported priorities by way of a contingent valuation method, Shechter et al. [39] look at monetary passive-use losses from damages to Israel's Carmel National Park. From yet another angle, Montgomery et al. [33] use a management price model to trace a marginal cost curve for biodiversity using 147 native bird species present in Monroe County, Pennsylvania. The method presented here, which we may call *experience production* (EP), shares several features with hedonic techniques. In experience production, people rely on attributes of instruments. Their outlays are payments for such attributes. In the same way households are willing to pay for the attribute 'ocean view' at waterfront residencies, households are willing to pay for the attribute 'capacity to carry on snow' skis have. Further, the similarity to CV methods is clear. In the same way households would report willingness-to-pay for restoring national parks or cleaning-up beaches to an investigator in a CV setting, experience production models let households report such willingnesses-to-pay through the reported purchase expenditure on cabin restoration and maintenance.

In order to analyze the importance of site features, techniques have been developed to study discrete choices between different alternatives. For example, Morey and Waldman [34] study the association between demand for recreational fishing and unobserved catch rates by estimating them simultaneously in a maximum likelihood framework. Here, I employ discrete choice theory to make interpretations of what a decision to purchase means. The interpretations are anchored in a household production theory.

5. Theory

5.1. **Production Function of Nature Experiences.** Households have preferences that can be represented by a ranking translated into a utility function, here denoted u(N, X; D). Nature experiences are denoted N and X represents all other commodities and experiences. Characteristics idiosyncratic to a household, for example demographic composition, are symbolized by the vector D. By using physical goods as necessary inputs in household production of a vector N of nature experience commodities, I follow Stigler and Becker [40] and build upon the theory Lancaster ([25] and [26]) put forward. In his outline of a technology of consumption, Lancaster [26] (p. 14) stated that 'The consumer's demand for goods arises from the fact that goods are

required to obtain characteristics and is a derived demand.' In this setting, nature experience tools equip the household with means to produce characteristics of nature experience. Lancaster [25] (p. 133) formulated the relationship between factors and output in an illuminating way: 'We assume that consumption is an activity in which goods, singly or in combination, are inputs and in which the output is a collection of characteristics.' The statement strikes the chord I will play.

The utility function used here is assumed to be weakly separable in X and N. In other words, U(N, X; D)=V($u_1(N;D), u_2(X;D)$). For simplicity, let U be the sum of $u_1(N;D)$ and $u_2(X;D)$, the sum of utilities extracted from nature experiences N and all other commodities and experiences X. We do not rule out corner solutions, in which a household finds producing N too costly and thus choose not to. When produced, N is produced using two factors: Nature attributes A and production instruments Y, as in Freeman's (op.cit.) exposition of household production of commodities. Thus, let us write N as N(A, Y). Let x be the subset of X that consists of marketable goods. Commodities and experiences X can be produced by combinations of purchasable goods x. The intersection of sets x and Y is empty, and collectively x and Y exhaust all purchasing possibilities.

It is not essential to our argument how the production function is structured as long as derivatives N_A and N_Y are positive, and as long as nature attributes A and tools Y are a necessary factors and complements. We assume that no nature experience can be produced with one factor only; attributes and equipment are both necessary and not singly sufficient: You cannot produce speed-on-snow experience with skis only in your living room, and you cannot produce speed-on-snow experience on a slope with no skis. The assumption is both a strong and an essential simplification. There are competing stories that may be told. First, the production function may change over time. It may, for example, become more equipment-intense over time. Households would then produce the same amount of nature experience using three back-packs, not one. Second, there may be a shift from purchasing in order to actually produce nature experience to purchasing in order to secure an option of standing ready to produce nature experience. Households may acquire equipment in order to own a quickly available option to go out-of-doors.

Notice that a story of increased factor intensity without any increase in production seems somewhat implausible unless man-hours involved change radically. Rational agents have access to former production methods and under active, binding budget constraints we assume households require that they get something out of higher expenditures. Households have a willingness-to-pay for improved quality and quantitty of nature experience or saved man-hours.[5]

Recreation factor Y is represented by two categories of market goods: an outdoor recreation good Y_r and a leisure home good Y_l. In summarizing and analyzing CES data, we study each category separately. We assume that households produce an outdoor recreation experience using Y_r as input and a leisure home nature experience using Y_l as input, but we are not concerned whether they use both at the same time. Y_r contains items such as camping gear, skis, skates, tents, sleeping bags, compasses, altimeters, fishing equipment and sailboards. The idea is that over the year, you may choose whether to produce utility (through nature experience) from the broader category outdoor recreation through skiing or biking the same way you may choose to produce bicycle experiences by using a Klein mountain-bike or a Fisher mountain-bike.

Freeman (p. 104) gives examples of nature attributes A: number of fish per volume water and water quality. Here, we may add scenery, absence of human edifices in parks, air quality, sounds, wildlife, ski tracks, flora and number of days with visible sun. When a household produces nature experience it chooses from a menu of possible activities. From a list of factors, it can employ camping gear, fishing equipment, down-hill skis or cross-country skis. When a

[5] A parsimonious model of nature attributes and equipment loses some power compared to a less parsimonious model of nature attributes, equipment, *and* manual labor. However, a model must use available data and no CES data contain labor time investments. The interpretation here is that increased expenses on skis entail increased production of speed-on-snow experience or an option of it, not saved labor input.

household does, it faces the following optimization program:

$$(5.1) \qquad max \quad U(N(A,Y),X;D) \qquad s.t. p_x x + p_y Y \leq R,$$

where R is disposable income and p prices. The household chooses optimal goods x and instruments Y. Consult Deaton and Muellbauer [10] (p. 220-226) for a treatment of implications of weak separability in the optimization. Kealy and Bishop [22] study properties of additive separability in recreation activity models, and may also be consulted.

I assume that the nature experience function N() is constant over our period, so that we can study Marshallian demand for nature tools as functions of prices, budgets, and nature attributes given demographic compositions of households, $Y = Y(p_x, p_Y, R, A; D)$.[6] Mäler [29] discusses the case in which nature attributes A and instruments Y are perfect complements. Bockstael and McConnel [8] show that utility increases that originate in changes in attributes A can be calculated through the market good Y's compensated demand function without knowing the structure of the nature experience production function N.

Changes in purchase expenditure $p_Y Y$ over time may result from changes in prices, budgets, preferences, nature attributes, knowledge, or the production function. Economists struggle to compare expenditures over time.[7] It is worthwhile for future studies to decompose purchase expenditure changes into different components, such as price effects, income effects or preference effects. For the questions at hand, it is not necessary and would expand the volume of the study.

5.2. **Participation Rate As Nature Value Referendum.** One simple way to measure demand for nature experience is to ask someone whether he or she would be willing to spend money on producing nature experience. Such an approach would be inspired by CV and mimick its method: Let people reveal their opinions and state their preferences. One common objection is that CV questions are hypothetical. Asking, without making people use their wallets, opens up an array of error sources. Indirect evidence methods have the advantage of observing actual market behavior. People do not only say they would spend money, they do. The researcher observes it. However, one problem in TC is that the people asked obviously have assumed costs since they are at the location and one does not know what caused others to refrain from going. CV suffers from hypothetical questions, but has the merit of sampling from a whole population. TC suffers from self-selection, but has the merit of observing actually spent money. Here, my aim is to combine merits without assuming all flipsides. We want to study a sample representing a whole population and we want to observe records of actual behavior. One way to do it is to consider reported expenditure as answering a question: 'Is producing nature experience worth anything to you? If no, write zero. If yes, write a positive number, namely the amount you have spent purchasing nature tools.' The existence of threshold prices and indivisibility of goods prevent us from knowing what level of demand zeros represent. The existence of thresholds allows detection of of time trends of popularity when the proportions of yes-sayers change over time.

The household makes a binary choice: To participate or not in producing nature experience. The decision is reflected in observed expenditures combined with noise. Zero observations of purchase expenditure can be a nuisance since there are several reasons why zero purchase observations occur in a data set. Let us look at some. First, the household may hold no interest whatsoever in the good and therefore chooses a corner solution. It would contradict our assumption of utility increasing in nature experience. Second, the household may have preference for nature experience and the household may produce nature experience, but purchases are infrequent and outside of the observation period[8]. The researcher observes a zero outlay that does not mirror zero consumption or demand. Third, the entry price may be prohibitively high;

[6] In a cross-section, households face the same price vector p. Conventionally, the researcher focuses on establishing a relationship between demand for a good and the budget. In the literature, the relationship is known as an Engel curve.

[7] The problem is long acknowledged and it has risen to prominent status in economics and thereby acquired a name: The Index Number Problem.

[8] Observation period is fourteen days.

at least higher than the willingness—the computed solution to the optimization problem—to pay for the good.[9] Additionally, a household may have no knowledge of or have acquired no skill in producing the activity. You might have enjoyed diving if you had known how to do it. Further, production may not be available. You would ski if you had lived in skiable areas; or you would swim if you had access to water. We see that a zero observation may stand in between the researcher and the household and mask true behavior. I concentrate the analysis on threshold effects.

In a cross-section study, zeros constitute a large hurdle. However, in a time series of independent cross-sections, the challenge posed by zeros may be converted to an opportunity of obtaining valuable information. We exploit systematic occurrences by studying the pattern of non-zero purchase proportions. A prerequisite is that zeros are not only measurement errors.[10] If we believe that a zero purchase expenditure arises a from corner solution that originates in a threshold effect, and thus stem from a deliberate decision of not to participate, we are in a position to use analytically the observed proportions of purchase from year to year. When a larger proportion of households in year t+s than in year t is observed to purchase nature tools we interpret proportion changes as indicators of increased popularity of nature experiences. We observe how households vote with their wallets: Some households find it worthwhile to pay for equipment to produce nature experiences, others do not. The referendum of one year can be compared to that of another.

The household faces a discrete/continuous choice: First, it must decide whether to purchase or not. Second, it must figure out how much to purchase if it does. If Marshallian demand for input nature tool Y had been a continuous function of prices, income and demographics we would have seen inner solutions. However, price and indivisibility thresholds transform non-zero purchase wishes into zero purchase observations, in the way Tobin [42] pointed out. The household will study available portions of equipment and compare the utility from producing nature experience; $U((R-p_{Y^0}Y^0)/p_X, N(A,Y^0); D)$, in which 0 denotes the minimum available amount; with the utility from not producing nature experience, $U(R/p_X, N=0; D)$. Observers do not see all entries of idiosyncratic elements of D; thus there is a gap between what the household acts upon and what the analyst sees. We collect those terms in a term ϵ. Hence, the observer will see a purchase when

$$v((R-p_Y Y)/p_X, N(A,Y); d) + \epsilon_1 > v(R/p_X, N=0; d) + \epsilon_0, \tag{5.2}$$

where d is a subset of D consisting of observable idiosyncratic elements of a household relevant to the choice. Here, v represents utility, but a different utility function than the U() that represents household preference rankings. The term ϵ accounts for the difference betweeen U() and v(). To the observer, ϵ is unknown, unobservable, and random. Manski [30] showed how this randomness could be interpreted; here it is ascribed to unobservable taste variation.

How the threshold effect divides the population into buyers and non-buyers is interesting and exploitable. Similar to how people in a referendum vote 'yes' if they have overcome doubt towards a given proposal, households can be seen as reaching non-zero purchases if their desires to experience nature overcome the costs associated with doing so. The proportion of households having decided to produce nature experience is our target because of the belief that proportion changes over time mirrors time changes of attitude towards nature.

A household will be observed purchasing equipment and lodging if the inequality holds and it will then participate in producing nature experience. The household has made a choice having faced a discrete outcome space consisting of two mutually exclusive alternatives: produce nature experience or not. Since sampling is done without replacement, the number of observed participating households is a stochastic variable governed by the hypergeometric distribution. The population participation rate p is given by the number of households that participates, M,

[9] Keen [23] deals several of the mentioned sources and adds another: Misreporting.

[10] If all households have positive latent consumption, zero expenditures result from infrequency of purchase. Changing purchase proportions would then have to be interpreted as generated from changes in bulk buying habits or data generation processes.

divided by total number of households in the population, N. Sample ratio $\hat{p}$ is the fraction of number of households that are observed as purchasers, m, to number of households in sample, H. It is an unbiased estimator of population participation rate p given that the sampling follows a simple, random sampling scheme.[11] An unbiased estimator of the variance of sample proportion[12] $\hat{p}$ is given by $\hat{var}(\hat{p}) = \hat{p}(1-\hat{p})(N-H)/(N(H-1))$, see Bhattacharyaa and Johnson [7] p. 561.

5.3. **A Tobit Model of Nature Experience.** Since a two-stage decision process is involved, a Tobit structure is an obvious starting point for modeling demand. Tobin [42] presented in his seminal article a model that deals with asymmetrically dichotomous data sets involving discrete/continuous variables; see also the excellent early article by Amemiya [2]. For an overview of the literature, see Amemiya [3]. Confer with Greene [14] (p.694-697) for an outline of Tobit structure and current estimation techinques using maximum likelihood and other alternatives.

Consider the following model for the latent underlying structure of demand:

$$\eta_{ih} = \beta_i Z_h + \epsilon_h, i \in I, h \in H, \tag{5.3}$$

where h refers to household and β is a vector of demand coefficients. η_{ih} is latent demand or consumption of household h for good i. I is a universe of goods and H is the set of households in the sample. Z is a vector of household characteristics, here limited to net income, number of children and number of adults. Prices are excluded in cross-sectional demand models since they are thought to be equal for all households for any given good. The stochastic term ϵ is assumed to be iid normal. Normality allows us to compute maximum likelihood estimators in a tractable manner and may serve as an approximation when error terms are non-normal.

The researcher observes

$$y_{ih} = \eta_{ih}, \eta_{ih} \geq L_{ih} \qquad and \qquad y_{ih} = 0, \eta_{ih} < L_{ih}, \qquad i \in I, h \in H, \tag{5.4}$$

where L_{ih} is a common ($L_{ih} = L_i$) or an idiosyncratic purchase threshold for household h. Y_{ih} is observed purchase expenditure of household h on good i. Entry to nature experience production may have price and indivisibility barriers so that the household cannot consume their optimal level because it is below an essential barrier. In the next section, we will describe specifics of the estimation process, including variables, software, and convergence procedures.

6. Data and Estimation Techniques

Data contain observations on household samples from Norwegian Consumer Expenditure Surveys [36] from 1975 to 1995 and income data for 1986 to 1995, see Halvorsen and Wangen [17]. Consumer expenditure surveys are conducted yearly and continuously by Statistics Norway. Statistics Norway obtains reports from more than 1000[13] households per year, independently[14] drawn. The survey is continuous with 1/26 of sample households reporting during the first fourteen days of the year, 1/26 during the next fourteen days and so on. The sampling scheme is a stratified, self-weighted[15], two-stage random sample of private households in Norway. The response rate is typically above 60 percent and most frequent reason for non-response is 'refusal to answer'.[16]

Income data were obtained from tax statistics from Norwegian IRS registers for the period 1986-95. Variables are gross income (pension earning income before tax) and net income (pension earning income after tax). IRS information is linked to the CES data by using social security numbers as identification variables.

[11] The sampling scheme is a stratified, two-stage random sampling.

[12] The formula applies to simple, random samples.

[13] For example, in 1995 CES data contained 1312 reporting households; in 1994 1337.

[14] A small subsample is drawn from the previous sample, thereby creating a small two-year panel.

[15] Until 1992.

[16] Statistics Norway has constructed non-response weights to realign the response sample attributes with population attributes, confer with Belsby [6]. The weights are used in computations when appropriate.

Data contain errors. Missing entries and typing mistakes have been found. For example, the year 1987 is problematic since it contains several missing data points. Outliers influence results. For one year the highest observed income was more than twice that of the second and four times as high as that of the third. Winsorization[17] is a possible remedy, but I have not implemented data transformation techniques. I have employed non-response weights when appropriate, and deleted observations with missing variables.

Surveys consist of several sources of information: interviews and account books. Interviews reveal information on socio-economic background, area of residence, descriptions and value estimates of some owned durables. Account books are kept for fourteen days and all purchases are written down by the household. Households do not themselves classify goods. Aggregation and categorization are done by Statistics Norway, and there are nine broad categories. The most detailed level consists of 526 goods. In our study, we inspected the description of each 526 goods and found that 20 would classify as factor inputs in producing nature experience. Two additional expenditure types from outside the CES system were added, namely V850 and V864. They are expenditures of nature tools, but not purchases of goods (see below). Obviously, there were border-line cases; for example, the good V707 'Hunting (and other) weapons and ammunition' was not included. This may seem as an innocuous choice, but potentially it may not be. In Norway, hunting is popular. I believe most hunting is done for nature experience production, and very little, if any, for subsistence. Yet I did not include it in our list of equipment because after consideration I found that hunting entails using nature in a slightly different way[18]than the goods I finally decided upon. I also left out: V350 Woollen underwear, V382 Winter hats and V340/341 Outdoor wear of plastic. These are too often used in regular day activities and for non-nature experience purposes. I performed sensitivity analyses, in which I included and excluded border-line goods. The analyses show that results are robust against inclusion and exclusion of border-line cases.

The final list of outdoor recreation equipment is: V327 Ski clothing and parkas, adult, V367 Bathing suits and swimming trunks, V411 Skiing boots and sporting shoes, adults, V412 Skiing boots and sporting shoes, children, V704 Sail boat, motor boat and boat engine[19], V705 Rowing boat and outboard motor, V706 Equipment and accessories for boat, V709 Skis and ski equipment, V710 Camping equipment (including tents, sleeping bags and air mattresses), V711 Other sportsarticles (including ice skates, sleds, fishing equipment, pocket knives, frogman's feet), V647 Bicycles (including mountain-bikes), V713 Sail boards (introduced in CES 1989) and V850 Fees for camping and closet.[21]

I hesitated before including V647 Bicycles because bicycles are also means of transportation. Norway has vast areas of nature inviting hikers and bikers, and the latter is a component in household nature experience production. Results were robust against exclusion of V647 Bicycles.

In this study, there are two aggregated goods: outdoor recreation equipment and lodging. To obtain expenses on lodging, I bundled together running expenditures on leisure home, not one-time purchasing outlays. Essentially, the rationale is to establish a *user expenditure*[22] of leisure home for the households with positive expenditure, reflecting consumption of leisure homes for each year. The category lodging or 'Leisure homes' includes expenditures related to usage of cabins, cottages and holiday houses. It is of major interest. Norway is a spacious country with

[17] One oftenseen winsorization scheme is to set observations below the second percentile to the level of the second percentile and observations above the ninety-eight percentile to the ninety-eigth percentile.

[18] Hunting is harvesting of wildlife. In principle, hunting is similar to fishing. However, there is a difference in degree of between hunting and fishing. My judgement is that fishing contains a larger element of contemplative recreation than hunting does. Yet we could argue for inclusion of hunting.

[19] Notice that for boats the purchase expenditure is defined as purchase expenditure subtracted by sale revenue. If a household sells a boat and does not purchase a new one, a negative purchase expenditure will result.[20] If the item is large enough it may render total purchase expenditure negative as well. In our estimation, negative expenditures are set to zero in order to comply with standard Tobit model.

[21] V850 is outside the CES accounting system. I included it because it is part of a 'user expenditure'.

[22] Compare the concept of user expenditure with the concept of user price.

only 4.5 million citizens. There is ample space cabins and cottages. There are huge mountain areas and accessible roads to them. There is a large system maintained hiking trails, as well as many ski resorts. Counties prepare and groom tracks for cross-country skiing and offer them for public usage free of charge. Norwegians cultivate a culture of outdoorsiness, and many households use cabins as a nature experience tool. A study conducted by Statistics Norway and Western Norway Research Institute [41], showed that 38 percent of the adult population (above 29) in 1999 owned their own leisure home or cabin, up from 34 percent in 1986. In 1999, only 36.4 percent of adult population between 29 and 79 years of age did not own or have access to leisure homes, down from 44.1 percent in 1986.[23] The same study examines popularity of activities in nature: 54.7 percent of adult population between 29 and 79 reported to have engaged in fishing during the year, up from 51.3 in 1986. 45.7 percent of adults between 29 and 79 reported to have done one long hike (at least one day) in the mountains, up from 33.2 in 1986.

Leisure homes or holiday houses are defined as cabins, cottages, and country houses. I do not estimate values of such houses, but observe expenditures connected to owning or renting, e.g. estimating an indicator for *user expenditure*. The expenditure on lodging or leisure homes contains the following goods: V441 Interest on Holiday house loans, V445 Insurance (not furniture) Holiday House, V448 Water charges holiday house, V455 Other charges holiday house, V464 Hire of holiday house, V864 Property tax on holiday house[24], V916 Work by others on holiday house, V917 Purchase of materials holiday house, and V934 Purchase of wall-connected equipment holiday house. The household is asked about the annual expenditures[25] of these entries in the last interview[26].

Notice that the CES system introduces new goods when a sufficient number of households is observed purchasing them, so that the coverage over time may differ. The CES system is at all times exhaustive of purchase expenditures, but into which category expenditures are put vary. For example, in 1989 V713 Sail board, which is included in outdoor recreation equipment, became a separate good with expenditures separately recorded on the most detailed level.

A complication of the data is the change of sampling scheme implemented in 1992. Sampling changed from an address based register of addresses in Norway to a person based register of persons in Norway. This change entailed a change of sampling probabilities. Larger households have one address but several members. Consequently, in 1992 the probability of drawing a large household increased. The average number of household members jumped from 2.64 in 1991 to 3.17 in 1992. This is a large discontinuity. Obviously, the change has ramifications for our estimates and trends. However, it does not hinder inference. First, it is a one-time change and we are interested in preference and participation changes from year to another. Changes between estimates for any other difference than 1992-91 would still be interesting changes. Second, use of corrective weights shows that patterns are sensitive to the sampling scheme change, but that every main trend is valid. When appropriate, I include statistics using corrective weights. Belsby [6] presents the algorithm of computation of weights using a Horwitz-Thompson estimator, which implies that household weights are inverse of sampling probability. In addition to bias from sampling probabilities, there is bias from non-responses. Belsby shows how non-responses affect the probability of receiving a report from a household in the population and how the response probability is modeled.

For the period 1986-1995, I ran Tobit regressions in the LIMDEP package of Greene [15] using net income, number of adults, and number of children below 16 years of age as exogenous right-hand-side variables (plus an intercept). Purchase expenditure of outdoor recreation equipment and leisure home expenditure were left-hand-side variables in two separate tobit regressions.

[23] Based on interwiews with 1595 people.

[24] V864 is not considered an expenditure in CES system, but I included it because it is part of a user expenditure.

[25] More specifically, the households are asked about expenditures during last twelve months, not calendar year.

[26] This study follows the CES convention in excluding instalments on leisure home loans. It is not considered part of a user expenditure. It is considered an investment.

TABLE 1. Tobit Regression of Outdoor Recreational Equipment (t-value)

Year	Intercep	Net Income	Childr.	Adults	Income Elasticity
95	-24642 (-8.2)	.731E-2 (2.4)	6914 (8.8)	3525 (3.1)	.32
94	-29683 (-10.4)	.299E-1 (4.8)	5073 (6.5)	3906 (3.6)	1.45
93	-34526 (-9.4)	.569E-1 (6.8)	6060 (6.0)	1018 (.70)	2.65
92	-39271 (-11.1)	.436E-1 (5.2)	5627 (5.9)	4280 (3.1)	2.12
91	-28863 (-11.1)	.439E-1 (6.0)	4543 (5.0)	2304 (2.0)	2.03
90	-28041 (-11.5)	.716E-1 (8.2)	2219 (2.6)	-2226 (-2.7)	3.23
89	-25573 (-10.7)	.737E-1 (8.3)	3675 (4.4)	-3688 (-4.4)	3.78
88	-13664 (-10.9)	.585E-1 (11.1)	2580 (5.7)	-2572 (-5.7)	2.98
87	-26976 (-12.0)	.804E-1 (7.7)	2676 (3.4)	-2665 (-3.4)	2.90
86	-30154 (-12.1)	.118E-1 (9.5)	3939 (4.3)	-3964 (-4.4)	.60

LIMDEP uses an iterative maximum likelihood procedure to find convergent parameter estimates. We used the standard option of optimization algorithm and missing-variables[27]. The default value for censoring limit is zero, at the left.[28]

Referendum results over the vote of willingness-to-produce nature experience are reported as participation rates. They are computed as the proportion of purchasing households in the sample for each year. Unity subtracted by the proportion yields the proportion of non-purchasers. I report both non-weighted and weighted proportions. To compute non-weighted and weighted participation rates, I let a variable RATE be unity if purchase expenditure is positive and zero otherwise. The non-weighted participation rate is simply a non-weighted average of the variable RATE, while a weighted participation rate is a weighted average of the varialbe RATE.

In order to compare proportions for two years, we to know distribution of the statistic or at least have simulations of it. In stead of approximating a two-stage, self-weighted, stratified sample by the hypergeometric distribution of a simple random sample, I employed non-parametric Monte Carlo bootstrap simulation of the distribution.[29]

7. Empirical Results

7.1. **Less of a Luxury? Elasticities of Nature Experience Instruments.** Instruments for producing nature experience remain luxury items over the period. Income coefficents remain quite stable over the period. Demographic coefficients of equipment show time development. The background for the results can be found in Table 1 and 2. In the tables, I have listed results of tobit regressions of household outdoor recreation equipment and lesiure home purchase expenditures onto a space of net income, number of children in household, and number of adults in household using the LIMDEP software package as detailed above. In the right column, I list the computed income elasticity[30].

[27] I advice caution in interpreting results from the year 1987. Numerous missing variables imply tenuous estimation results.

[28] Negative observations are effectively set to limiting level, Greene p. 661 and p. 696.

[29] Non-parametric bootstrapping involves the following algorithm: i) Generate a sample b of size H (same size as observed data set) by sampling *with* replacement using a random number generator for the uniform distribution to select which observations to put into the simulated data set. ii) Compute the desired parameter estimate for this new simulated sample b. iii) Repeat the two steps above B times, obtaining B estimates of the parameter. iv) The B estimates constitute an estimate $\hat{H}_B(\hat{\theta})$ of the distribution $H_h(\hat{\theta})$ of the parameter estimate $\hat{\theta}$. v) Employ the estimated distribution in test procedures for statistical significance. For example, the variance of the simulated distribution will be an estimate of the variance of the parameter estimate.

[30] The income elasticity is measured at one particular point on the demand curve. The elasticity is defined as the ratio between the regression slope of Net Income and the budget share. Budget share is measured by the sum of purchase expenditure of the good divided by the sum of net income. Sums are computed over households. Alternatively, as denominator in the budget share one could use the sum of total expenditures, if there were a wish to include wealth effects as found in total purchase expenditures absent in net incomes. Additionally, one could use the slope of total expenditure as numerator. I did not because the endogeneity of total expenditure

TABLE 2. Tobit Regression of Leisure Home (t-value)

Year	Intercep	Net Income	Children	Adults	Income Elasticity
95	-7002 (-7.0)	.349E-2 (3.4)	301 (1.1)	991 (2.6)	.55
94	-13442 (-11.0)	.219E-1 (6.3)	-537 (-1.4)	526 (1.4)	2.15
93	-10131 (-8.4)	.136E-1 (5.0)	145 (.42)	784 (1.6)	1.70
92	-14182 (-9.7)	.184E-1 (5.3)	411 (1.0)	1223 (2.1)	1.93
91	-12107 (-9.1)	.214E-1 (5.7)	-556 (-1.1)	512 (.83)	2.10
90	-7961 (-11.4)	.133E-1 (5.8)	-608 (-2.5)	607 (2.5)	1.46
89	-12836 (-9.9)	.227E-1 (5.6)	-199 (-.43)	1174 (2.1)	1.99
88	-10850 (-9.0)	.144E-1 (3.4)	686 (1.6)	535 (.98)	1.23
87	-16204 (-14.1)	.341E-1 (6.8)	-258 (-.65)	259 (.66)	2.87
86	-10686 (-12.9)	.278E-1 (7.4)	-62.0 (-.21)	59.7 (.21)	2.67

Inspection Table 1, we see a slight upward trend in the estimated coefficient for number of children in household in the dmeand for equipment. The coefficient for number of adults in household shows a clear time trend. The coefficient increases. In 1986, an additional adult in a household, holding income and number of children constant, was associated with a decrease in equipment purchase. In 1995, an extra adult is associated with higher equipment expenditure. Larger families seem to increase production of nature experience. We do not detect similar trends in lodging estimates of Table 2.

Notice that Net Income coefficients are of the same magnitude for most years for both equipment and lodging. Interestingly, recreation equipment and lodging are found by empirical scrutiny to be luxury items for almost all years. Naturally, coefficient estimates and income elasticities vary from year to year. This comes as no surprise to empirical microeconometricians. However, the pattern of elasticities above unity is remarkable. There are only three anomalous estimates. Two outliers are found in the 1986 and 1995 estimates of Net Income coefficient on purchase expenditure of outdoor recreational equipment; they are both much lower than other estimates. The third low estimate is the 1995 income coefficient of leisure homes. I can offer no explanation, only speculation, for the estimates. They all occured in times when the Norwegian economy expanded rapidly, so estimates may be connected with easing of credit.

In Table 3, I present summary statistics of the income elasticities over the period 1986-95. The mean income elasticity of Outdoor recreational equipment is 2.21, and the mean income elasticity of Leisure Home is 1.87[31]. The high standard deviations should not be too disturbing. Few years and thus few observations will entail substantial variations. Elasticity means of 2.21 and 1.87 are of substantial interest, standard deviations less so. The small sample problem[32] created by 10 observations demands careful interpretation. Economically, the income elasticities are noteworthy since they signal that households in a cross-section find it worthwhile to increse their purchases of nature experience instruments as they become richer, number of household members held constant. Of course, the 1995 estimates may signal an onset of a different purchasing pattern. Equipment and lodging may come to be perceived less as luxury items—and more as necessary inputs in an active outdoorsy lifestyle. On the background of one year, we cannot make such an inference.

(as in errors-in-variables models) would make it unsuitable as a left-side-variable. Notice that if we had chosen to measure the elasticity at another point on the demand curve, the elasticity would change accordingly. We observe, for example, that budget shares for both equipment and lodging among households that have non-zero purchases are about double those of the whole population.

[31] If we use purchase expenditure's share out of *total purchase expenditures* in stead of their share of net income, we obtain higher elasticities. Such budget shares yield an elasticity estimate for outdoor recreation equipment at 2.51 and an elasticity estimate for leisure homes at 2.13 for the period.

[32] Confer with McCloskey and Ziliak [31] for a discussion of the difference between statistical and economical significance. A longer observation period would create more estimates, but may not affect the mean of coefficients. Large standard deviations are related to few observations.

TABLE 3. Income Elasticities, 1986-95

Good	Period	Mean	Median	Std. Dev.	Min	Max
Equipment	1986-95	2.21	2.39	1.13	.32	3.78
Lodging	1986-95	1.87	1.96	.68	.55	2.87

7.2. **Referendum Result: Voting With Wallets Shows Increased Popularity.** The proportion of households with non-zero purchase expenditure of equipment and lodging increased over the period. The statistical regularity of households reporting more frequently that they buy tools for experiencing the out-of-doors suggests increased popularity of nature experience production.

It was possible to construct a high-quality time-series of participation rates for outdoor recreation equipment covering the period 1975-1995. For leisure home expenditure I constructed a time-series from 1986 to 1995. Leisure home data before 1986 are unreliable.[33] Confer with Røed Larsen [37] for a discussion of and an attempt at extending the period for leisure home participation to 1975.[34]

We see in Table 4 that the participation rate for equipment increases from .278 (.301) for the weighted[35] (non-weighted) rate to .350 (.462) in 1995. Recall that the weighted average is an attempt to control for sample selection effects. For leisure homes the participation rate was .288 (.315) in 1986. In 1995, the participation rate had risen to .365 (.417).

Samples are drawn from populations, so sample proportions may vary even when population proportions do not. Do the sample proportion changes we observe mirror population proportion changes? When sample proportion increases from .278 to .350 two decades later, should we infer that the population proportion also increased? Sample proportions are estimates generated from random samples and thus stochastic variables with a distribution[36]. To estimate the distribution of the proportion estimates, I employed the bootstrap.

In Table 5, we find summarizing statistics from non-parametric Monte Carlo bootstrap simulations of the distribution of the participation rate for outdoor recreation equipment in 1991. We observe that one thousand simulations of both weighted and non-weighted participation rates resulted in means identical to the original point estimates at the second decimal: .351 (.384, non-weighted) for the simulated mean and .350 (.384) for the original estimate. Simulations indicate that standard deviations are small, of magnitude .0133. A difference in participation rate between 1994 and 1995 of .352-.350=.002 does not indicate change in population participation rate. It is probably a sampling-caused difference. On the other hand, a difference in participation between .278 in 1975 and .350 in 1995 most likely reflects a population change. Simulations of distributions allow a claim of increased population participation rate for outdoor recreation equipment purchase in the period. In 1986, the participation in producing lodging services stood at 28.8[37] percent. In 1995, it had increased to 36.5 percent, reflecting increasing popularity of leisure home usage. The finding supports the patterns Teigland [41] detected. Similarly, increases in sample proportions of positive purchases of lodging are sufficiently large

[33] An overhaul of the CES data generation method was implemented in 1986. While equipment expenditures are recorded in account books, interest payments are recorded by interviews. Before 1986, if households answered that they did pay interest on leisure home loans, but did not remember the amount, the expenditures were entered as zero. Beginning in 1986, such expenditures were imputed to the mean expenditure for all households.

[34] Analysis presented by Røed Larsen indicates that data for leisure home expenditures were, in fact, seriously affected by the 1986-overhaul. For example, even if the variable V441 Interest on Holiday Home Loans in 1986-95 correspond with the variable FH1 in the period 1975-85, a suspicious discontinuity in proportion of households with non-zero purchase expenditure was found.

[35] Confer with the section for Data and Estimation Techniques for a description on how the participation rates were obtained.

[36] Simple, random samples are governed by the hypergeometric distribution. Our samples are more complex, they are two-stage, stratified samples. We do not know the exact distributions of the observed proportion rates.

[37] Weighted.

TABLE 4. Proportion of Households With Non-zero Expenditure, Non-w./Wgd.

Year	Equipment		Lodging	
75	.301	.278		
76	.322	.299		
77	.310	.300		
78	.267	.249		
79	.305	.278		
80	.319	.291		
81	.350	.322		
82	.347	.316		
83	.286	.257		
84	.353	.315		
85	.355	.326		
86	.378	.341	.315	.288
87	.393	.353	.345	.323
88	.368	.330	.353	.335
89	.340	.302	.358	.339
90	.367	.335	.348	.331
91	.384	.350	.371	.353
92	.446	.348	.390	.334
93	.462	.337	.394	.332
94	.461	.352	.420	.369
95	.462	.350	.417	.365

TABLE 5. Bootstrapping Participation Rate, Outdoor Equipment, 1991

Statistic	No. Simul.	Mean	Std.Dev.	Min	Max
W. Participation	1000	.351	.0133	.303	.388
Un-w. Participation R.	1000	.384	.0138	.342	.427

between 1986 and 1995 that it is legitimate to claim that more households in the population have lodging expenditures.

8. Limitations and Discussion

The empirical patterns remain patterns regardless of our analysis and interpretation. They represent interesting statistical regularities. Such regularities are challenges. We investigate, scrutinize, and comment in an effort to identify satisfactory explanations. Here, one interpretation is offered: Outdoor recreation goods and leisure home expenditures have quite stable income coefficients, they are luxury items, and usage of them increases in popularity.

Evidence provided by CES data has limitations. One important restriction is the fact that although our CES data are divided into 526 different goods, the disaggregation is not sufficiently detailed. Tents and skis clearly are equipment not suited for many other purposes, but bicycles are. Ideally, we would be able to differentiate between to-work bicycles and off-road mountain-bikes. However, differentiation is not all. Equipment may serve multiple objectives. Sleeping bags can be purchased for other purposes than to experience nature. Ski jackets are fashionable and may equip users with fashion instruments, not nature experience tools. Lodges and cabins may provide an escape of daily routine much the same way a stay at a city hotel room can; the escape of routine being the purpose, not nature experience production. In interpreting summary statistics, we must use caution. Projection of large data sets into a few interpretable scalars is a tenuous endeavor since our interpretation is only one of several possible, even plausible.

In order to ski, you need skis, clothing, and lodging. You also need transportation. Gas, car maintenance, train tickets and airfare are all observed outlay categories, but are used not only to produce nature experience. Ideally, fine-grid data would make it possible to separate gas bought to get to work from gas purchased for going skiing. When data categories are put together, the observer cannot disentangle effects and usages. Good V824 'Domestic package tours' include expenditure for nature production, but it includes non-nature travel expenses as well. People need food when they produce nature experiences, but from CES data we cannot differentiate between different settings of food consumption. This is unfortunate, but we may still obtain valuable information. If latent expenditures relate to observables in a constant pattern, knowledge-limiting factors are constant, too. Then, we may detect trends of demand for latent service demand when we discover time changes in observable expenditures.

Zero expenditures constitute a challenge. Interpretations of zero purchases differ, see Keen [23]. Here, we treat zero purchases as decisions arising from a household optimization problem, in which the optimal amount of purchase expenditure could not be realized because of entry barriers of price and divisibility. Another way of treating zero purchases would be to consider them as results of errors in variables. In errors-in-variables models, households consume but may not be observed as having purchased, because the purchase took place outside of the observation period. Indeed, I have analyzed how sensitive elasticity results are to such a specification. I used a standard errors-in-variables model. In it, a measurement error accounts for the difference between observed purchase and latent consumption or demand. Latent consumption is a function of latent total consumption and demographic variables. I use observable purchase expenditure and total purchase expenditure for latent consumption and latent total consumption. Total purchase expenditure is not exogenous, then, since it contains an aggregate of measurement errors. As a right-hand-side variable it is in fact not stochastically independent of the error terms. Thus, ordinary least squares is flawed by estimation bias. To avoid obtaining biased coefficient estimates, I used a two-stage-least-square approach with gross and net income as instruments. Details of model set-up and results are presented in Røed Larsen [37]. Estimated elasticities from an errors-in-variable approach are mostly above unity. The mean of leisure home elasticities 1986-95 is 2.34 and 2.20 for equipment in the period 1975-86 and 1.08 for equipment in the period 1986-95. In the errors-in-variable specification, fluctuations of estimates are considerable, and negative estimates of elasticities hint that the errors-in-variables model is inadequate and less plausible than the tobit structure used here.

Non-responses are problematic. Non-response weights adjust sampling probabilities. Mean sample household size can be adjusted to concur with mean population household size. We still do not know if there are important idiosyncracies attached to non-respondents. We do not know if they change over years, a change that may confound time trends. Presence of non-respondents does not invalidate investigation, but may contribute to trends in ways we do not control for.

Production of nature experience may become more equipment intense over time. If it does we are not necessarily right in interpreting our results as production of *more* nature experience. Perhaps we should interpret our results as showing the increased usage of one factor, tools, possibly reflecting the decrease of man-hours. Some households today have many skis and many back-packs—earlier households had one pair of skis and one back-pack—possibly without producing more nature experiences. It is hard to see why households would acquire a canoe, or an additional one, without producing more canoe-related experiences. If we assume that knowledge of production functions does not disappear, it is reasonable to believe that an increase in equipment-intensity leads to improved outcomes. Households could always choose to produce nature experience by using old production functions. The new factor mix is preferable and households are willing to pay for it. Households improve factor mixes and gain something. That something may be difficult for the researcher to observe; the researcher focuses on inputs. Nevertheless, increased purchase and transfer of non-market activity to market-activity reveal willingness-to-pay for the improvement in outcome.

Engel curve and income effect estimation goes far back in economics, and is notoriously hard. Many models are offered in the literature, see e.g. Aasness and Rødseth [1] and Banks et al. [4]. Linear Engel and income curves may seem simple or even implausible, but they may show excellent local approximations. My view is that the tobit model utilized here offer a valuable first approximation. Further sophistication may yield additional valuable insights. Allowance for preference heterogeneity may be offered through finite-mixture or random coefficient models. Curvature can be studied by use of polynomials in total consumption and non-parametric applications. Model selection techniques promise optimal choice from a list of right-hand-side variables that may be potential determinants of purchase expenditure on a given good. In estimation of Engel or income effect, a researcher makes many choices. For example, I use a standard definition of purchase expenditure.[38] Nevertheless, the standard of allowing negative entries when a household sells equipment but does not purchase new items or purchases lesser-valued new items, is essentially an ad hoc rule. Aggregation is another issue. Should we study one or n goods? We must consider similarities and examine differences between goods. I decided to group nature experience tools into the two aggregate goods equipment and lodging from an exhaustive pool of 526 goods and an additional list of non-purchase expenditures such as taxes and fees. Arguably, we could divide into three or four goods.

There are questions of interest for future research. One such issue is durability. Households may be observed purchasing outdoor equipment because they produce it more often or because the equipment becomes less durable. Quality changes are well-known causes of data misinterpretations. Price effects are related to quality changes. Marshallian demand is a function also of relative prices. If nature experience becomes cheaper to produce we expect more households to produce it—everything else being the same. If prices, habits, and mean income change at the same time interpretation becomes difficult. As it is, this study relegates price effects to a constant term. We observe that the constant term changes over time, but what to make of it is nebulous.

If we could get access to prevailing price vectors over the time period the study would be enhanced in interpretability and scope. Consider a simple standard demand equation of the form $y_{jt} = \gamma_j p_{jt} - \beta_j \sum_k (p_{kt}\gamma_k) + \beta_j y_t + \theta_j z_j$, where y is total consumption, j denotes good j, z is a vector of demographic attributes, p relative real price, and t time. We would know much more about the nature of demand if we knew structural parameters γ. In this study, we lump the first two terms into a constant term. Thus, when relative real prices change the constant term changes, too, everything else being the same. However, our constant term would change also if relative prices were unchanged but price coefficients (i.e. preferences) changed. We do observe that the constant term becomes larger in absolute value over time.

Every researcher must make up his or her mind on the appropriate methodology. Should she be a judge considering all evidence, or a barrister advocating one interpretation? Different opinions exist, and my approach borrows something from both. We have studied demand of nature experience as illuminated by one model, one data set, and few essential metrics. Should we balance evidence carefully with doubt and claim only what is proven withut doubt? Or should you proclaim 'I have found cold fusion' when you might have, only to add 'Well, maybe' later in a section of discussion or in subsequent articles? There is something attractively refreshing and inspired with the latter view and something reassuringly safe and sober with the former view. This article represents a middle position: I do make modest inferences, but do add reservations.

9. Concluding Remarks and Policy Relevance

Equipment and lodging are luxury items since estimated income elasticities are above unity. One natural interpretation of equipment and lodging usage relies on the model Lancaster suggested; they are inputs in an effort to require certain characteristics of output. Equipment and lodging are factors in the production of nature experience. As factors, the luxury status

[38] Used by statistical agencies.

has predictive value for demand for nature experience in the future. It is reasonable to expect households to increase their production of nature experience as they grow richer. We observe that the household size coefficients of equipment demand increases over time. Thus, an increase in family size for a given income is associated with more money spent on equipment in 1995 than an increase was in 1986.

The proportion of households with positive purchase expenditure on equipment and lodging increases over time. Positive purchase is interpreted as a 'yes' to a question of willingness to pay for participation in the production of nature experience. Increases in participation rates of both goods increase over time are consistent with the luxury status of these items. Society becomes richer and can spare more time and resources to extracting out-of-doors enjoyment out of the budget. Nature services are essential inputs in creating nature experiences, and when demand for tools increases attendant demand for nature services is thought to increase too. Money receipts contain evidence of desire to enjoy nature.

The results have policy implications. Forecasts of expenditures on equipment and lodging are possible when we have found them to be luxuries, especially when the luxury status seems robust over time. Demand increases steeply in income, reflecting households' preferences for nature tools. The demand for nature attributes will increase too, then, under an assumption of complementarity. In Norway, there is already conflict between the commercial interests of farmers and timber producers on the one side and the experience interests of hikers, campers, and recreational visitors on the other. They compete for utilization of the same areas for mutually exclusive activities. The establishment of national parks is controversial for the same reason, as is the construction of dams and river piping for electricity generation. Looking at the time trends found in this study, one may speculate that there will be a growing number of such conflicts as society demands areas and resources for *both* commercial and experience production. Purchase expenditure signals willingness-to-pay for nature services, which implies growing concern for natural and environmental qualities. In the future, households may for that reason become increasingly interested in protecting natural amenities and keeping pristine nature areas exactly that.

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