Are Travelers Willing to Pay a Premium to Stay at a "Green" Hotel?

Evidence from an Internal Meta-Analysis of Hedonic Price Premia

Nicolai V. Kuminoff
Assistant Professor
Dept. of Economics
Arizona State University
Tempe, AZ
kuminoff@asu.edu

Congwen Zhang
Ph.D. Student
Applied Economics
Virginia Tech
Blacksburg, VA
wen2007@vt.edu

Jeta Rudi *
Undergraduate
Dept. of Economics
Berea College
Berea, KY
jeta.rudi@gmail.com

December, 2009

* We thank Joshua Duke, Chris Parmeter, Jaren Pope, and two anonymous referees for helpful comments and suggestions on this research. Kuminoff's work on this project was supported by the USDA Cooperative State Research, Education & Extension Service, Hatch project # VA-135832. Research support for Jeta Rudi from Berea College is also gratefully acknowledged.

Are Travelers Willing to Pay a Premium to Stay at a "Green" Hotel?

Evidence from an Internal Meta-Analysis of Hedonic Price Premia

ABSTRACT: A growing number of hotels provide "green lodging" for travelers with strong environmental preferences. Twelve states have developed certification programs to regulate these claims. After describing the new market for green lodging, we use data on prices and amenities of "green" and "brown" hotels in Virginia to estimate a hedonic model of hotel room pricing. We find that travelers can expect to pay a significant premium for a standard room in a green hotel. An internal meta-analysis is used to evaluate the robustness of this result to subjective econometric modeling decisions. Our results indicate a premium between $9 and $26.

KEY WORDS: Green Lodging, Hedonic, Hotel, Internal Meta-Analysis.

JEL CODES: Q51, Q53, C52.

Green goods have become big business. Market prices reveal that consumers are willing to pay a premium for hybrid cars (Kahn 2007), solar electricity (Kotchen and Moore 2007), fair-trade coffee (Loureiro and Lotade 2005), and eco-labeled seafood (Johnston et al. 2001), to name only a few examples. Paying a premium for these "green" goods lets people feel like they are doing their part to help the environment or to help workers in developing countries. Mainstream retailers are cashing in on this sentiment. Wal-Mart, Kmart, and Target have all expanded their product line to include goods labeled as "green" or "sustainable", while making great efforts to advertise their company's commitment to the environment.[1] This growth seems likely to continue in the near future. Applications to the U.S. Patents and Trade Office with the word "green" more than doubled between 2006 and 2007 (Deschert LLP, 2008).

Over the past few years, the domestic travel industry has begun to capitalize on the demand for green goods by providing differentiated services for travelers with strong environmental preferences. Airline passengers can purchase credits to offset the carbon emitted during their flight, motorists can rent a hybrid or electric vehicle, and when travelers spend a night on the road, they can choose to stay at a green hotel. In the first two markets, the retailer's environmental claims are easily verified. A traveler can observe the fuel reduction from driving a hybrid car and retailers of carbon offsets receive frequent audits. In comparison, it is difficult for a traveler to verify a hotel's

[1] For example, a search on the word "green" on Wal-mart's website returns links to green products, tips for "green living", and information about the chain's commitment to the environment.

"greenness". Recognizing this information asymmetry, twelve states have begun to regulate the environmental claims made by their hotels and inns. These "green lodging" programs define standards for environmentally friendly lodging and certify hotels that meet these standards. The programs are mostly concentrated in the Northeast and South Atlantic (Delaware, Florida, Massachusetts, North Carolina, Pennsylvania, Rhode Island, Vermont, Virginia) and in other major travel destinations (California, Hawaii, Michigan, Wisconsin). All of the state programs share a similar objective: to reduce energy consumption, water consumption, and pollution in the lodging sector while allowing participating hotels and inns to take advantage of the demand for green goods and services. Similar programs exist in parts of Europe and Australia (Spilanis and H. Vayanni 2004; Dalton, Lockington, Baldock 2008).

Going green can decrease a hotel's rate of energy and water consumption. However, the conversion process can require large sunk costs for energy-efficient and water-efficient appliances, as well as higher operating costs associated with purchasing environmentally benign cleaning supplies and recycled paper products. These costs may, in turn, be passed on to travelers through higher room rates. Are travelers willing to pay a premium to stay at a green hotel? We investigate this question.

Using data on the room rates and amenities of "green" and "brown" hotels in Virginia, we estimate a hedonic model of hotel room pricing. The results from a series of simple linear regressions suggest that, all else constant, a standard room in a green hotel is between $17 and $23 more expensive than a standard room in a brown hotel. However, like most empirical hedonic studies, our estimate for this implicit price reflects our maintained assumptions about the true shape of the equilibrium price function and our choices for which hotel amenities to include as covariates in the model. Recent work in the broader literature on nonmarket valuation has suggested a need to assess the sensitivity of estimates for nonmarket values to the researcher's subjective modeling decisions (Banzhaf and Smith 2007; Kuminoff 2009). Therefore, as a robustness check on our results, we estimate a large number of randomly chosen specifications for the hedonic price function (40,000) and then perform a meta-analysis to synthesize our results, following the procedure outlined by Banzhaf and Smith (2007). While we almost always find a statistically significant price premium for green hotels, the magnitude of the premium depends on which variables are included in the model as regressors.

Overall, our analysis makes three contributions to the literature on the demand for green goods and hedonic valuation of amenities. First, we introduce the emerging domestic market for green lodging. With nearly a billion hotel and motel room nights purchased in the United States each year (Patkose, Burnett, and Cook 2007), lodging represents a major market with the potential to reveal new information about consumer preferences for green goods and services. Second, our hedonic estimates suggest that travelers are willing to pay a premium for green lodging. This result builds on the evidence from past hedonic studies which have found that rental prices of vacation properties tend to depend on their proximity to environmental amenities (e.g. Taylor and Smith, 2000; Molard, Rambonilaza, and Vollet 2007) and that, in general, consumers are willing to pay a premium for a "greener" version of a private market good (e.g. Nimon and Beghin 1999; Johnston et al. 2001; Loureiro and Lotade 2005). Finally, our sensitivity analysis represents the first application of internal meta-analysis to evaluate the robustness of reduced-form hedonic estimates to subjective econometric modeling decisions. Recent quasi-experimental studies have stressed the need to think carefully about the implicit or explicit assumptions that identify hedonic estimates for implicit prices (e.g. Pope 2008; Greenstone and Gayer 2009). Internal meta-analysis provides a simple way to decompose the identifying power of assumptions about hedonic functional form and which covariates to include in the model.

The remainder of the paper proceeds as follows. We begin by using national data on internet traffic to document the growing consumer interest in green lodging. This is followed by a description of Virginia's green lodging certification program. Then we develop a hedonic model of equilibrium room rates and use it to focus our subsequent discussion of empirical modeling issues. After describing our data on green and brown hotels in Virginia we present baseline econometric results and perform the meta-analysis. Finally, we conclude by discussing topics for future research.

Background

Tracking Consumer Interest in Green Lodging

How big is the market for green lodging? The twelve state programs have collectively certified nearly one thousand hotels and inns. While there are no national statistics on the number of annual visits to green hotels, we can develop a rough sense of recent trends in consumer interest by studying internet traffic. According to national survey data from the U.S. Travel Industry Association, 80.4% of travelers with internet access used the internet to plan their trips in 2007 (Fesenmaier and Sheatsley 2008). For these online travelers, the web provides a wealth of information about green lodging. For example, it has been profiled in multiple travel features for CNN and MSNBC (e.g. Lovitt 2009). Moreover, the descriptions of individual hotels provided by the major booking websites (e.g. Expedia, Travelocity, Orbitz) include information about each hotel's greenness. For example, Travelocity's search results include a green leaf-shaped icon for "eco-friendly hotel" displayed prominently beneath the universal blue icons for "wheelchair access" and "no smoking". Alternatively, users can browse Travelocity's directory of eco-friendly hotels.

To develop a quantitative measure of consumer interest in green hotels, we use the *Google Trends* search engine to track the online search volume for phrases that prospective travelers are likely to use in a search for green lodging. The *Google Trends* tool extracts normalized time series data on searches for any word or phrase.[2] Google does not provide raw data on the number of searches. Instead, it provides an index of search volume. For example, figure 1A displays a monthly index for the volume of U.S. Google searches from 2004 through 2008 that included the word 'hotels'. The index is normalized by setting the mean search volume during this period equal to 1.0. The cyclical pattern in the volume of search traffic makes sense. The troughs occur in December and January when people tend to stay home for the holidays. The peaks occur in July when people tend to go on vacation. The large drop between 2007 and 2008 matches the onset of recession in the U.S. economy. We have also added a linear trend

[2] Choi and Varian (2009) describe these data. Their econometric analysis suggests the data can help to explain automotive sales, housing starts, and the volume of international travel.

line to the figure, which demonstrates that, overall, the search volume for 'hotels' trended down during this five year period.

Figure 1B displays the search volume for the phrase 'green hotels' during the same five-year period. While the cyclical pattern is essentially the same as for 'hotels' the time trend is reversed. The volume of search traffic for 'green hotels' trended up between 2004 and 2008. This would suggest a growing relative interest in green hotels on the part of prospective travelers.[3] To help explain this interest and to provide a clearer definition of the management practices that characterize green lodging, we now turn to a descriptive summary of one of the largest state operated certification programs.

A Closer Look at a State Certification Program: Virginia Green Lodging

With just over 300 participating hotels and inns as of July 2009, *Virginia Green Lodging* is among the largest state programs. It is administered by the Virginia Department of Environmental Quality (VDEQ). Hotels and inns seeking to obtain the "Virginia Green" seal must demonstrate that they participate in each of five "core" activities: (i) optional linen service; (ii) recycle and reduce waste; (iii) water conservation; (iv) energy conservation; and (v) developing the capacity for hosting green events, conferences, and meetings. Participation in each of these broadly defined activities can be demonstrated through one or more specific management practices approved by VDEQ. Table 1 provides examples of the acceptable management practices in each of the five core areas

---

[3] Searches for the phrases 'green travel' and 'green lodging' suggest similar upward trends in interest.

together with the share of green hotels that engage in that practice.[4] For example, 89% of Virginia's green hotels and inns provide guests with the option to reuse sheets and towels rather than washing them every day, 84% recycle aluminum cans, and 83% avoid the use of disposable plates and cutlery. Other green activities are less common. 41% of the participating hotels and inns use biodegradable laundry detergent, 20% donate excess food from meetings and events, and only 8% have solar panels.

Once a hotel has applied for membership in the program, officials from VDEQ visit the facility to verify that it participates in the five core activities. The lodging facility is then granted membership in the program and can display the "Virginia green" seal in its advertisements. Most participating hotels display this seal on their webpages. Travelers can also learn about Virginia's green hotels by browsing internet travel sites. For example, the homepage of the *Virginia Bed and Breakfast Association* prominently features a searchable database of Virginia's certified bed and breakfast inns. Likewise, the state's official tourism program (*Virginia is for Lovers*) features a searchable online database of all of Virginia's green lodging facilities. Travelers seeking more information about the management practices of specific hotels can browse through the VDEQ website, which profiles each green hotel and describes the management practices it has undertaken to obtain certification.

Virginia's green lodging program is fairly representative of the programs operated by other states. Most programs provide detailed descriptions of the green activities

[4] Facilities are not limited to these activities. They are also encouraged to practice other "green" activities that best fit their lodging facility.

undertaken by each hotel and feature searchable databases of hotels for prospective travelers. The main difference between Virginia's program and those in other states is that membership in Virginia's program is discrete. Every hotel and inn in Virginia is either certified green or not certified at all. In contrast, the programs operated in California, Florida, and Michigan distinguish between various levels of participation. For example, California green hotels that satisfy a minimum level of participation in the program are awarded "one palm" status whereas hotels that participate in additional activities are awarded "two palm" status.

The Virginia Green Lodging program maintains that their certification process conveys multiple benefits to hotels and travelers including pollution reduction, conservation of natural resources, and marketing strategies that target environmentally-conscious guests. Some in the hospitality industry also view green lodging as an opportunity to hedge against potential future regulation (Butler 2008). In equilibrium, all of these supply and demand shifters should affect the price charged for a room.

A Hedonic Model of Hotel Room Pricing

Equilibrium in the market for hotel rooms can be characterized using a hedonic model. In general, hedonic models express the price of a differentiated product as a function of its characteristics. While the conceptual basis for this approach dates back to the 1920s, Rosen (1974) strengthened the economic foundations of the method by demonstrating that the hedonic price function can be interpreted as an equilibrium relationship resulting from the interactions between all the buyers and sellers in a market. Under the assumptions of his model, regressing product prices on their attributes can reveal consumers' marginal willingness-to-pay (MWTP) for individual attributes of a differentiated product.

Hedonic models are frequently used to estimate the implicit prices of amenities capitalized into residential property values such as water clarity near lakefront property (Gibbs et al. 2002), proximity of a home to agricultural open space (Geoghegan, Lynch, and Bucholtz 2003), and tree damage from invasive species (Holmes, Murphy, and Bell 2006). Previous studies have also developed hedonic models of rental rates for vacation properties (Taylor and Smith, 2000; Molard, Rambonilaza, and Vollet 2007) and of green goods such as ecolabeled apparel (Nimon and Beghin 1999). However, this study is the first to estimate the price premium for green lodging in the market for hotel rooms.

To formalize ideas, let the price of a hotel room, P, be expressed as a function of the hotel's environmental stewardship, g, and a vector, $\mathbf{X}$, which describes all other characteristics of the room and the hotel such as whether the room is a suite, the number of stars of the hotel, whether it has free high speed internet, and its proximity to nearby business centers and tourist attractions. Using this notation, the hedonic price function can be expressed as: $P = P(g, \mathbf{X})$. Equation (1) illustrates how the hedonic price function enters a traveler's utility maximization problem. Each traveler will choose a quantity of the composite numeraire good (b) and a hotel with the set of characteristics that maximize their utility, given their preferences, $\boldsymbol{\alpha}$, and income, y.

$$(1) \qquad \max_{b,g,\mathbf{X}} U(b, g, \mathbf{X}; \boldsymbol{\alpha}) \quad subject\ to \quad y = b + P(g, \mathbf{X}).$$

The first order conditions to this utility maximization problem provide one of the key results of the hedonic model. Equation (2) shows the first order condition for g.

(2) $$\frac{\partial P(g,\mathbf{X})}{\partial g} = \frac{\partial U/\partial g}{\partial U/\partial b}.$$

Travelers will maximize their utility by choosing a hotel which provides them with the level of environmental stewardship at which their marginal willingness-to-pay exactly equals its marginal implicit price.

To model the supply side of the market, let $C(g,\mathbf{X};\boldsymbol{\beta})$ denote the hotel's cost function, where $\boldsymbol{\beta}$ is a vector of parameters describing the costs faced by the hotel. The hotel's profit maximization problem can be defined as (3).

(3) $$\max_{g,\mathbf{X}} \ \pi = P(g,\mathbf{X}) - C(g,\mathbf{X};\boldsymbol{\beta}).$$

Each hotel chooses the $g,\mathbf{X}$ combination that maximizes their profits, given $\boldsymbol{\beta}$. Equation (4) defines the corresponding first order conditions for g.

(4) $$\frac{\partial P(g,\mathbf{X})}{\partial g} = \frac{\partial C(g,\mathbf{X};\boldsymbol{\beta})}{\partial g}.$$

The hotel chooses g to set the marginal cost of environmental stewardship equal to its marginal implicit price. Assuming perfect competition, equilibrium in the market for green lodging occurs when the first order conditions in (2) and (4) are simultaneously satisfied for all travelers and hotels.

The gradient of the equilibrium price function that satisfies (2) and (4) provides an estimate of what travelers are willing to pay for green lodging. It also provides an estimate of the marginal cost of providing green lodging. Therefore, the empirical challenge is to estimate $P(g,\mathbf{X})$ econometrically using data on room rates and characteristics.

Empirical Model

Data Sources and Modeling Issues

Empirical hedonic analysis begins by defining the scope of the market. We chose to focus on the market for hotels, as opposed to bed and breakfast inns, because hotels represent the vast majority of the hospitality industry. To collect data on the characteristics of Virginia hotels we used the "Hotel-Guides" online search engine to systematically extract information on the room rates and characteristics of hotels throughout the state of Virginia in the summer of 2008.[5] This allowed us to assemble a comprehensive set of hotel characteristics, as well as the minimum price charged for a single night stay in a standard room at each hotel. Then we checked each hotel against the database of "Virginia green" hotels provided by the Virginia Department of Environmental Quality in order to determine which ones had received green certification. Finally, we used GIS software to measure the distance from each hotel to the following amenities: the city of Washington D.C., the city of Richmond, public beaches on the Virginia coast, and the Appalachian Trail which serves as a proxy measure of

---

[5] We chose this search engine over other candidates such as *Expedia*, *Travelocity*, and *Orbitz* because it offered the most comprehensive set of hotel characteristics for Virginia. Their website is http://hotel-guides.us/virginia/va-hotels.html. The data were collected in July 2008.

opportunities for mountain recreation.[6] Figure 2 shows the locations of the 223 hotels in the data we assembled overlaid on the nine “tourism regions” defined by the Virginia Department of Tourism.

Table 2 reports summary statistics for the characteristics of hotels. The minimum rate for a basic room ranged from $39 to $269. The average facility had 5 floors with 120 rooms and a room rate of $99. All other characteristics were measured using indicator variables. Common characteristics include an indoor swimming pool (73%), free internet in the lobby (71%), a fitness center (61%), a convention center (58%), and free continental breakfast (53%). Uncommon characteristics include in-room kitchenettes (18%), being entirely smoke-free (13%), and tennis courts (12%). Most of the facilities in our data were hotels with either 2 or 3 stars and 10% of them had received the “Virginia green” certification from VDEQ. Most of the hotels are located in the *Central Virginia*, *Northern Virginia*, and the *Shenandoah Valley* tourism regions. Just over 80% of the hotels are located in a Census-defined urban area, and many of them are located within 20 miles of: the Appalachian Trail (42%), a public beach (22%), Washington D.C. (17%), or the city of Richmond (15%).

In order to develop an estimable hedonic model from our data on hotel characteristics and room rates, three modeling issues must be addressed. The first issue is the distinction between market prices and offer prices. The market price of lodging that

---

[6] The Appalachian Trail runs through the major mountain recreation areas in Virginia: Shenandoah National Park, Mount Rogers National Recreation Area, and the George Washington and Jefferson National Forests.

would be consistent with the hedonic model in (1)-(4) is determined by the distribution of rooms that are actually rented. Ideally, one would collect data on this distribution by combining posted room rates with occupancy records. The difficulty is that occupancy records are not publicly available.[7]

Without occupancy records, our analysis must rely on the maintained assumption that transactions actually occurred at the offer prices we observe. A parallel assumption is often made in the hedonic property value literature when the "price of housing" is defined using Census data on the values that homeowners report for their homes (e.g. Greenstone and Gayer, 2009). Kiel and Zabel (1999) investigate the validity of this assumption by comparing actual sale prices to self-reported values. They found that the median homeowner overstated the sale price of their home by 5.1%. Importantly, the size of the error declined with the homeowner's experience in the market, specifically their tenure in the home.[8] We would expect there to be a similar effect from experience in the market for lodging. Hotel managers have near continuous feedback on market

[7] One way to obtain occupancy data is to contact firms directly. This is most effective in situations where a small number of firms account for a large share of transactions. For example, Taylor and Smith (2000) persuaded four property management firms to share their occupancy records for hundreds of beach rental homes on North Carolina's "Outer Banks". These firms accounted for about 40% of the market. In contrast, there are hundreds of hotels in Virginia, each of which accounts for a small share of the market.

[8] The error was also found to be uncorrelated with housing characteristics, suggesting it would be absorbed by a constant in a hedonic regression.

conditions, which should give them the information needed to post prices that will lead to high occupancy rates. Furthermore, unlike the market for housing, there is little or no scope for bargaining once room rates are posted.

If the rates that were posted during the summer of 2008 exceeded what travelers were actually willing to pay, so that vacancy rates were high, we would expect to see posted rates decline. In fact, we observe the opposite. The average posted rate increased by 14% between July 2008 and September 2009.[9] Meanwhile, relative prices were fairly stable. The average price change for the cheapest quartile of hotels (+14.2%) was only slightly larger than for the most expensive quartile (+13.4%). The stability in relative prices over this short period is consistent with the standard depiction of equilibrium in the empirical hedonic literature, and the increase in the average price is consistent with our maintained assumption that market transactions were occurring at the room rates posted during the summer of 2008.[10]

---

[9] This comparison is based on 191 of the 223 hotels that reported rates for both periods. Specifically, the comparison is between rates posted in July 2008 for reservations in early September 2008 and rates posted in September 2009 for reservations in mid October 2009. As a robustness check, we also collected data on reservations for mid January 2010. Rates were virtually unchanged from October 2009 (less than one tenth of one percent higher). We thank an anonymous referee for suggesting the idea of examining changes in pricing behavior over time.

[10] While Rosen's (1974) theoretical model depicts equilibrium at a single point in time, it is common in the empirical literature to use intercept shifters to control for changes in the price of

The second empirical modeling issue is the need to select a parametric form for the hedonic price function. The difficulty is that the true shape of the price function is unknown and estimates for implicit prices will be conditioned on our assumption about its parametric form. While theory suggests the price function is generally nonlinear (Ekeland, Heckman, and Nesheim 2004) most empirical hedonic studies use a specification that is linear in parameters. This follows from Cropper, Deck, and McConnell's (1988) Monte Carlo analysis of how the accuracy in predicting MWTP varies across competing functional form assumptions. They find that simpler parametric specifications for the price function—linear, log-linear, log-log, and linear Box-Cox—outperform more flexible specifications in the presence of omitted variables. Therefore, adopting one of these simpler functional forms can help to hedge against the risk of omitted variable bias. Given the dichotomous nature of almost all the potential independent variables in table 1, the linear and log-linear functional forms seem most appropriate for our study. Yet there is no *a priori* rationale for choosing between these two functional forms. Therefore, it seems prudent to estimate the model both ways.

The final modeling issue is that it is difficult to determine which hotel characteristics should enter the equilibrium price function. Omitting hotel characteristics that travelers care about may bias estimates for the marginal implicit price of g if the omitted characteristics are correlated with g or with any other independent variables. On the other hand, including characteristics in the model that do not affect travelers'

---

the composite good, holding the relative implicit prices of its characteristics fixed. See Palmquist (2005) for a discussion.

choice process can reduce the efficiency of the estimator, artificially inflating the standard errors on g and the other independent variables. This is a general problem that applies widely within hedonic modeling and elsewhere in applied econometrics, and is of particular concern when the sample size is relatively small, as in the current application.[11]

It seems likely that the hedonic price function should include measures of overall service and quality such as the facility's star rating and at least a subset of the on-site amenities it provides, such as internet access for business travelers and opportunities for leisure. It is less clear whether room rates should depend on features of the facility that seem unlikely to affect the marginal cost of service, such as the presence of a convention center or a restaurant in the hotel. It is also unclear whether travelers actually consider all of the variables in our data when they choose where to stay. Green certified hotels typically display the "Virginia Green" seal prominently on their main webpage, but one often has to delve more deeply to learn about many of the other amenities in table 2. Recent evidence suggests that consumers may not seek out information on all of the characteristics of a differentiated product, even when making major purchases. For example, Pope (2008) finds that while homeowners are willing-to-pay a substantial premium to avoid living in an airport noise zone, many homebuyers appear to be unaware of whether their home is located inside a noise zone at the time of purchase. It seems reasonable to expect similar behavior in the hotel industry; that is, at least some travelers are probably uninformed about some hotel amenities. Thus, it would be prudent to

[11] For a formal analysis of the econometric consequences of including irrelevant variables in a regression see Greene (2000), p. 337-338.

estimate a variety of specifications for the price function, using different combinations of covariates, and then report the sensitivity of estimates for the green lodging price premium to the choice of covariates.

With two potential choices for the shape of the price function (linear, log-linear), and 24 potential independent variables that could be included or excluded from the model (assuming the "basic" variables in table 2 are always included), there are over thirty-three million possible specifications for the estimating equation.[12] While the dimensions of an empirical hedonic specification search are rarely defined in such explicit terms, the problem itself is quite common. The standard approach is to perform an ad hoc specification search that involves estimating a manageable number of models that seem intuitively plausible and then reporting an even smaller subset of the results in published research. This highly selective approach to reporting the results from a specification search has two disadvantages. It can omit potentially useful information and, more importantly, it can invalidate the statistical properties of the research design (Leamer, 1983). A more satisfying approach would be to find a concise way to report the robustness of results to a broad class of plausible specifications. This can be done using

[12] Specifically, we have $\#\,\text{models} = 2 * \sum_{i=1}^{20} \frac{24!}{i!(24-i)!} = 33{,}554{,}430$. The first term denotes the number of choices for the dependent variable and the summation represents the number of possible combinations of independent variables included in the regression. Inside the summation, 24 is the number of potential variables that could be included and *i* is the number that are actually included. Inclusion of all the tourism region indicator variables is treated as a single modeling choice.

meta-analysis.

Using Meta-Analysis to Decompose the Identification of Price Premia

Since the pioneering studies by Smith and Kaoru (1990) and Walsh, Johnson, and McKean (1989), meta-analysis has been widely used in environmental economics to summarize the empirical evidence on important problems and to conduct benefit transfers. Meta-analysis can provide a simple and informative way to summarize results across a large number of distinct studies that investigate a common problem. This has been the primary use of the method over the past twenty years (Nelson and Kennedy 2009). Recently, Banzhaf and Smith (2007) proposed a second role for meta-analysis. It can also be used in the context of a single study to investigate how the researchers' subjective modeling decisions influence their economic predictions. Since the objective is to explain systematic variation in the results *within* a single study, Banzhaf and Smith dub their approach "internal" meta-analysis.[13]

An internal meta-analysis begins by estimating a large number of plausible econometric specifications for the same underlying model. The set of specifications can be defined systematically using all possible permutations of modeling choices made along a small number of predefined dimensions, as in Banzhaf and Smith (2007). Or the

---

[13] Meta-analysis has also been used to summarize results across different case studies within a single article. Messer et al. (2006) and Kiel and Williams (2007) estimate separate hedonic property value models for each of several Superfund sites and use meta-analysis to describe how variation in site characteristics influences their estimates for the discount associated with living near a site. Neither study investigates the role of econometric modeling decisions.

set of specifications can be randomly chosen within predefined bounds on a large number of dimensions, as in our subsequent analysis. In either case, each candidate specification for the true model is defined by a set of indicator variables describing its econometric features (such as functional form, the set of regressors, and the definition for the choice set) and by a set of variables describing economic outcomes (such as statistical significance of key parameters, elasticities, or welfare measures). Regressing economic outcomes on indicator variables for features of the econometric specification can help to summarize the ways in which the researchers' subjective modeling decisions influence their findings.

There are at least three reasons why an internal meta-analysis can be especially valuable in the context of a new application such as green lodging. First, the lack of prior evidence on econometric specification underscores the importance of performing a specification search. The specification generating process used to create the data for the meta-analysis can be designed to address Leamer's (1983) concern about the ad hoc nature of conventional specification searches. Second, a single table of meta-regression coefficients can be used to synthesize the key results from a comprehensive sensitivity analysis that would take far too much space to include in a journal article or even a supplemental appendix. The comprehensive nature of this approach can provide strong evidence on the robustness of a key result or reveal its fragility. Third, by identifying which subjective modeling decisions make the largest contributions to economic outcomes, an internal meta-analysis can reveal the modeling issues that are most deserving of attention in future research.

Baseline Econometric Results

We begin by presenting the results from estimation of a simple linear hedonic price function. These results serve as a baseline for comparison to the subsequent meta-analysis. Equation (5) displays the general specification.

(5)
$$P_j = \beta_0 + \beta_1 green_j + \beta_2 rooms_j + \beta_3 floors_j + \boldsymbol{\delta} \cdot \mathbf{star}_j$$
$$+ \boldsymbol{\gamma} \cdot \mathbf{facility}_j + \boldsymbol{\varphi} \cdot \mathbf{transportation}_j + \boldsymbol{\eta} \cdot \mathbf{dining}_j$$
$$+ \boldsymbol{\kappa} \cdot \mathbf{business}_j + \boldsymbol{\theta} \cdot \mathbf{entertainment}_j + \boldsymbol{\xi} \cdot \mathbf{space}_j + \varepsilon_j .$$

The dependent variable (P_j) denotes the minimum price for a standard room at hotel *j*, independent variables in italics represent scalars, and other independent variables represent vectors of variables from the corresponding categories in table 2, except for $\mathbf{space}_j$ which represents a vector of the following spatial variables: (i) fixed effects for tourism regions; (ii) a fixed effect for hotels located within Census defined urban areas; (iii) fixed effects for hotels located within 20 miles of Washington DC, Richmond, a public beach, and the Appalachian Trail; and (iv) interactions between the "20-mile" fixed effects and the linear distance to each amenity. The "20-mile" fixed effects measure the price differential associated with being located "near" a specific amenity; i.e. within a short drive. The interactions measure the continuous variation in the price differential that occurs as we move closer to the amenity, within the 20-mile zone of proximity.

Estimates for the coefficients and their standard errors are reported in table 3. The first column in the table reports the results from the simplest specification where room rates are regressed on the basic set of independent variables. All of these variables have the expected signs, intuitively plausible magnitudes, and are statistically significant. All else constant, larger hotels and hotels with higher star ratings tend to be more expensive, as we would expect. For example, the estimates imply that moving from a 1-star hotel to a 3-star hotel would increase the room rate by $35.74 and moving from a 3-star hotel to a 4-star hotel would increase the room rate by an additional $51.98. The coefficient on green certification in column [1] implies that, all else constant, the least expensive room in a "Virginia green" hotel costs approximately $23 more than the least expensive room in a hotel without green certification. This point estimate decreases as we introduce more comprehensive sets of covariates in columns [2] through [4].

The second column in table 3 reports the results from adding indicator variables for characteristics describing the facility, including whether it is smoke free, allows pets, and contains a convention center. Column [3] reports the results from an unselective "kitchen sink" version of the regression where we add all of the remaining variables from our database of hotel characteristics. These additional variables describe features of the hotel related to dining, business, and leisure. Finally, column [4] adds spatial variables. Even after controlling for the average price differentials associated with the tourism regions, we find that room rates are significantly higher for hotels located within 20 miles of Washington DC ($36.89) and for hotels located within 20 miles of a beach ($42.64). While the interaction terms all have the expected negative signs, the only one that is statistically different from zero is the coefficient on distance to a public beach. Its coefficient indicates that, all else constant, moving 1000 meters (0.62 miles) closer to a public beach increases the minimum room rate by $2.41 within the 20-mile zone of proximity. Including all of the covariates in the model increases the coefficient of variation substantially ($R^2 = 0.68$) compared to the parsimonious specification in column [1] ($R^2 = 0.41$).

Overall, the regression results appear to make intuitive sense. As we move from left to right in the table, the coefficients on the indicator variables for star rating decline in magnitude and in statistical significance. This reflects the correlation between star rating and linear combinations of the facility, dining, business, and leisure opportunities provided by the hotel. In other words, the star ratings largely reflect differences in these amenities. The most general specification in column 4 implies that travelers are willing to pay a substantial premium to stay in a suite ($26.59), to avoid staying in a hotel that allows pets ($13.69), to have access to a fitness center ($11.73), and to obtain 4-star service ($60.01). Travelers are also willing to pay more for internet access in their rooms ($12.17) but not for internet access in the lobby.

Based solely on the results in table 3 we would conclude that travelers are willing to pay a premium of between $17.09 and $22.82 to stay in certified “Virginia green” hotels relative to Virginia hotels without certification. However, this conclusion is conditioned by our subjective decisions about the econometric features of the model.

Internal Meta-Analysis of the Econometric Specification

To generate the data for our internal meta-analysis, we ran 40,000 regressions based on two general specifications for the parametric form of the equilibrium hedonic price function. The specifications differ in whether they define the dependant variable as P_j or $\log(P_j)$. For each specification, we ran 10,000 regressions using different combinations of covariates. Every specification included the "basic" group of hotel characteristics (green certification, star rating, and number of rooms). The specifications differed in which of the remaining 18 hotel characteristics were included in the set of covariates. On each of the 10,000 individual replications, we used random draws from a uniform distribution to select between 1 and 18 of these characteristics to serve as regressors. Finally, the entire process was repeated with and without the spatial variables. After estimating each of the 40,000 randomly-chosen models, we saved the OLS point estimate for the green lodging price premium, the p-value from a test of whether the point estimate is statistically different from zero, and dummy variables for each modeling decision.[14] These summary statistics serve as the data for our meta-analysis.

Figure 3 illustrates the distribution of 40,000 estimates for the green lodging price premium. The estimates range from \$5.72 to \$27.29 with a mean of \$17.16. Table 4 presents the results from our meta-analysis based on this distribution. Column [1] reports the results from an OLS regression of the green lodging price premium on indicator variables for econometric modeling choices:

(6) $$w_i = \alpha + \boldsymbol{\lambda} \cdot \mathbf{covariates}_i + \nu \cdot depvar_i + \pi_i \,.$$

In the equation, w_i represents our point estimate for the price premium from model *i*,

[14] The premium in the logarithmic model is adjusted using the Halvorsen-Palmquist (1980) correction.

$\mathbf{covariates}_i$ is a vector of dummy variables indicating whether each covariate was included in the model, and $depvar_i$ is an indicator variable for whether the dependent variable was measured in levels or logs. The R^2 of 0.9123 indicates that almost all of the variation in our point estimates for the price premium can be explained by the econometric features of the model.[15] The constant ($21.74) defines our prediction for the green lodging price premium when only the basic variables are included in the model (star rating and number of rooms). All of the other coefficients describe how each modeling decision tends to influence our estimates. For example, all else constant, including an indicator variable for whether all the rooms in the hotel are suites (*all suites*) leads to a small (18 cent) increase in our estimate for the price premium.

There are two conclusions to be drawn from column [1]. First, our initial finding of a positive price premium in the simple linear model is quite robust to the definition for the dependent variable and our choice of covariates. Any combination of econometric modeling choices will lead us to predict a positive price premium. If we exclude all of the variables that tend to increase our estimates for the price premium (i.e. those with positive coefficients) we would still predict a premium of $8.97. That said, our second conclusion is that the magnitude of the predicted price premium is quite sensitive to the econometric features of the model.

---

[15] As a second measure of goodness of fit, notice that the results in column [1] of table 4 are consistent with table 3. For example, the meta-analysis would predict a price premium of $21.74 when only the basic variables are included in the regression. This is very close to the estimate in table 3 ($22.82).

There is one hotel characteristic that has a substantial negative effect on our estimate for the price premium: whether the hotel is smoke free (-$4.36). Four other characteristics collectively decrease the price premium by another two dollars (*resort*, *jacuzzi*, *pets allowed*, and *business center*). The spatial variables are quite important. Including them in the model tends to decrease our prediction for the price premium by $5.38. Our decision about how to define the dependent variable also contributes to the magnitude of our econometric estimates. Measuring the dependent variable in logs decreases the point estimate by $0.63.

The OLS results in column [1] focus solely on the magnitude of our point estimate for the price premium. They do not provide any information about statistical significance. Therefore, column [2] reports the results from a probit model where the dependent variable is set to equal 1 if and only if the green lodging price premium is positive <u>and</u> statistically different from zero at the 90% level. Since all of the covariates are indicator variables, their coefficients are directly comparable. Thus, the probit results indicate that the two most important modeling decisions are whether to include the spatial variables and the dummy variable for whether the hotel is entirely smoke free. While we are agnostic about the inclusion of the *smoke free* dummy, we feel strongly that the spatial variables are necessary to help control for local attractions that may lead to higher prices in resort areas or near major cities.

Overall, 89% of the 40,000 regressions produce statistically significant estimates for the green lodging price premium. Furthermore, the p-values in the remaining 11% of regressions are clustered near our threshold for statistical significance, with an average value of 0.16. Thus, our initial finding of a statistically significant price premium for green hotels is very robust to alternative specifications for the hedonic price function. We interpret this as strong revealed preference evidence that consumers are willing to pay a premium for green lodging.

Conclusions

Ten of the twelve state programs for certifying green hotels were established between 2004 and 2008, and trends in internet traffic during this period suggest that prospective travelers have shown a growing interest in opportunities for green travel. Using data from a cross-section of green and brown hotels in Virginia, we have demonstrated that travelers can expect to pay a price premium for a standard room in a green hotel. Our point estimate for the size of this premium ranges from $8.97 to $25.43. This range does not reflect a confidence interval on a single point estimate. It reflects upper and lower bounds on our prediction for the price premium based on an internal meta-analysis of 40,000 possible econometric specifications for the hedonic price function. In other words, rather than report a single point estimate that is conditioned by our (untested) assumptions about the shape of the price function, we have reported a range of estimates that reflects our uncertainty about the true shape of the equilibrium price function and our uncertainty about which other hotel amenities would be capitalized into equilibrium prices. While this approach reveals our uncertainty about the exact magnitude of the price premium, the positive lower bound on the resulting range of estimates increases our confidence that a premium for green lodging does, in fact, exist.

In principle, one could develop a more precise point estimate for the price premium by exploiting the continuing certification process as an instrumental variable. In other words, one could collect data on room rates for individual hotels before and after they receive certification and then use a first-differenced regression to estimate the rate at which green certification is capitalized into hotel room prices. This approach would parallel the discontinuity designs that have become increasingly popular in the hedonic literature on the capitalization of amenities into residential property values (e.g. Pope 2008; Greenstone and Gayer 2009). It would also purge time-constant characteristics. Since the green certification process is unlikely to affect other hotel amenities, these amenities would drop out of the model, decreasing the dimensionality of subjective modeling choices to be evaluated through meta-analysis. This could increase the precision of econometric estimates for the green lodging price premium.

Another direction for future research would be to survey the travelers who visit green hotels to learn about their personal characteristics and their behavior in other markets. Kahn (2007) finds that registered voters of the green party tend to put their money where their mouth is when it comes to long-term decisions like where to live, what type of car to drive, and whether to commute by public transportation. The market for green lodging offers a window into the short-term decisions of consumers. Are the travelers who visit green hotels doing so because it is consistent with the rest of their lifestyle? Or are these travelers taking a vacation from a lifestyle that is less environmentally oriented? The answers to these questions could help to clarify the relationship between individual consumption of durable and non-durable green goods.

References

Banzhaf, S.H. and V.K. Smith. 2007. "Meta Analysis in Model Implementation: Choice Sets and the Valuation of Air Quality Improvements." *Journal of Applied Econometrics* 22(6): 1013-31.

Butler, J. 2008. "The Compelling "Hard Case" for "Green" Hotel Development." *Cornell Hospitality Quarterly* 49(3): 234-44.

Choi, H. and H.R. Varian. 2009. "Predicting the Present with Google Trends." *Google Research Paper*, http://google.com/googleblogs/pdfs/google_predicting_the_present.pdf, last accessed December 15, 2009.

Cropper, M.L., L.B. Deck, and K.E. McConnell. 1988. "On the Choice of Functional Form for Hedonic Price Functions." *Review of Economics and Statistics* 70(4): 668-75.

Dalton, G.J., D.A. Lockington, and T.E. Baldock. 2008. "A survey of tourist attitudes to renewable energy supply in Australian hotel accommodation." *Renewable Energy* 33(10): 2174-85.

Dechert LLP. 2008. "2008 Dechert LLP Annual Report on Trends in Trademarks."

Ekeland, I., J.J. Heckman, and L. Nesheim. 2004. "Identification and Estimation of Hedonic Models." *Journal of Political Economy* 112(1): S60-S109.

Fesenmaier, D.R. and D.W. Sheatsley. 2008. "Travelers' Use of the Internet." *Travel Industry Association*, Washington D.C.

Geoghegan, J., L. Lynch, and S. Bucholtz. 2003. "Capitalization of Open Spaces into Housing Values and the Residential Property Tax Revenue Impacts of Agricultural Easement Programs." *Agricultural and Resource Economics Review* 32(1): 33-45.

Gibbs, J.P., J.M. Halstead, K.J. Boyle, and J. Huang. 2002. "An Hedonic Analysis of the Effects of Lake Water Clarity on New Hampshire Lakefront Properties." *Agricultural and*

Resource Economics Review 31(1): 39-46.

Greene, W.H. 2000. *Econometric Analysis, Fourth Edition*. New Jersey: Prentice Hall.

Greenstone, M. and T. Gayer. 2009. "Quasi-Experimental and Experimental Approaches to Environmental Economics." *Journal of Environmental Economics and Management* 57(1): 21-44.

Halvorsen, R. and R.B. Palmquist. 1980. "The Interpretation of Dummy Variables in Semilogarithmic Equations." *American Economic Review* 70(3): 474-75.

Holmes, T.P., E.A. Murphy, and K.P. Bell. "Exotic Forest Insects and Residential Property Values." *Agricultural and Resource Economics Review* 35(1): 155-66.

Johnston, R.J., C.R. Wessells, H. Donath, and F. Asche. 2001. "Measuring Consumer Preferences for Ecolabeled Seafood: An International Comparison." *Journal of Agricultural and Resource Economics* 26(1): 20-39.

Kiel, K. and M. Williams. 2007. "The Impact of Superfund Sites on Local Property Values: Are All Sites the Same?" *Journal of Urban Economics* 61(1): 170-92.

Kiel, K. and J. Zabel. 1999. "The Accuracy of Owner-Provided House Values: The 1978-1991 American Housing Survey." *Real Estate Economics* 27(2): 263-296.

Kahn, M.E. 2007. "Do Greens Drive Hummers or Hybrids? Environmental Ideology as a Determinant of Consumer Choice." *Journal of Environmental Economics and Management* 54(2): 129-45.

Kotchen, M.J. and M.R. Moore. 2007. "Private Provision of Environmental Public Goods: Household Participation in Green-Electricity Programs." *Journal of Environmental Economics and Management* 53(1): 1-16.

Kuminoff, N.V. 2009. "Decomposing the Structural Identification of Nonmarket Values." *Journal of Environmental Economics and Management* 57(2): 123-39.

Leamer, E.E. 1983. "Let's Take the Con Out of Econometrics." *American Economic Review* 73(1): 31-43.

Lovitt, R. 2009. "Eclectic Accommodations for Eco-Travelers." *MSNBC*. April 14, 2009.

Loureiro, M.L. and J. Lotade. 2005. "Do Fair Trade and Eco-labels in Coffee Wake Up the Consumer Conscience?" *Ecological Economics* 53(1): 129-38.

Messer, K.D., W.D. Schultz, K.F. Hackett, T.A. Cameron, and G.H. Mcclelland. 2006. "Can Stigma Explain Large Property Vlaue Losses? The Psychology and Economics of Superfund." *Environmental and Resource Economics* 33(3): 299-324.

Mollard, A., T. Rambonilaza, and D. Vollet. 2007. "Environmental Amenities and Territorial Anchorage in the Recreational-Housing Rental Market: A Hedonic Approach with French Data." *Land Use Policy* 24(2): 484-93.

Nimon, W. and J. Beghin. 1999. "Are Eco-Labels Valuable? Evidence from the Apparel Industry." *American Journal of Agricultural Economics* 81(4): 801-11.

Nelson, J.P. and P.E. Kennedy. 2009. "The Use (and Abuse) of Meta-Analysis in Environmental and Natural Resource Economics: An Assessment." *Environmental and Resource Economics* 42(3): 345-77.

Palmquist, R. B. 2005. "Property Value Models," in *Handbook of Environmental Economics, Volume 2*. Karl-Göran Mäler and Jeffery Vincent eds. Amsterdam: North Holland Press.

Patkose, M., T.T. Burnett, and S.D. Cook. 2007. "Domestic Travel Market Report." *Travel Industry Association*.

Pope, J.C. 2008. "Buyer Information and the Hedonic: The Impact of a Seller Disclosure on the Implicit Price for Airport Noise." *Journal of Urban Economics* 63(2): 498-516.

Rosen, S. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82(1): 34-55.

Spilanis, I. and H. Vayanni. 2004. "Sustainable Tourism: Utopia or Necessity? The Role of New Forms of Tourism in the Aegean Islands," in *Coastal Mass Tourism: Diversification and Sustainable Development in Southern Europe*. Bill Bramwell ed. Clevedon: Channel View Publications.

Smith, V.K. and Yoshiaki K. 1990. "Signals or Noise? Explaining the Variation in Recreation Benefit Estimates." *American Journal of Agricultural Economics* 72(2): 419-33.

Taylor, L.O. and V.K. Smith. 2000. "Environmental Amenities as a Source of Market Power." *Land Economics* 76(4): 550-68.

Walsh, R.G., D.M. Johnson, and J.R. McKean. 1989. "Issues in Nonmarket Valuation and Policy Application: A Retrospective Glance." *Western Journal of Agricultural Economics* 14(1): 178-88.

Table 1. Activities Performed by Hotels in Virginia's Green Lodging Program [a]

Green Activities	% of Green Hotels Participating
Linen	
Optional linen service	89%
Water-efficient washers and dryers	57%
Non-toxic, biodegradable laundry detergents	41%
Recycling and Waste Reduction	
Aluminum cans	84%
Plastic	77%
Toner Cartridges	51%
Bulk soap dispenser instead of individual soaps	32%
Use dishware and glassware, not disposables	83%
Donate excess food from events	20%
Use organic and "sustainable" foods	24%
Use recycled paper products	31%
Water conservation	
Preventative maintenance of drips and leaks	86%
High efficiency dishwashers	54%
Microfiber technology mops	8%
Effective storm water management	25%
Energy conservation	
High efficiency lights	37%
High efficiency heating & air conditioning	68%
Solar panels	8%
Fuel-efficient vehicles or hybrids	15%

[a] Note: these practices serve as examples of the activities that can be used to qualify a hotel for "Virginia green" status. A more complete list is available from the program website: http://www.deq.virginia.gov/p2/virginiagreen. In order to qualify for "Virginia green" status, hotels must also be willing to offer a "green" package for conferences, meetings, and other events.

Table 2. Summary Statistics Describing 223 Virginia Hotels [a]

Category	Variable	Mean	Std. Dev.	Min	Max
Basic	price	99.121	44.63	39	269
	green certification	0.099	0.30	0	1
	1-star	0.126	0.33	0	1
	2-star	0.399	0.49	0	1
	3-star	0.422	0.49	0	1
	4-star	0.054	0.23	0	1
	# rooms	119.709	79.35	23	585
Facility	# floors	4.789	3.74	1	21
	motel	0.063	0.24	0	1
	hotel	0.897	0.30	0	1
	resort	0.040	0.20	0	1
	smoke free	0.130	0.34	0	1
	all suites	0.112	0.32	0	1
	kitchenette	0.179	0.38	0	1
	pets allowed	0.489	0.50	0	1
	convention center	0.583	0.49	0	1
Dining	free breakfast	0.534	0.50	0	1
	resturant in hotel	0.354	0.48	0	1
Business	free internet (lobby)	0.709	0.46	0	1
	internet (room)	0.511	0.50	0	1
	business center	0.453	0.50	0	1
Leisure	pool	0.731	0.44	0	1
	fitness center	0.610	0.49	0	1
	tennis court	0.117	0.32	0	1
	golf	0.251	0.43	0	1
	jacuzzi	0.139	0.35	0	1
Spatial Variables					
tourism region	Blue Ridge Highlands	0.009	0.09	0	1
	Heart of Appalachia	0.117	0.32	0	1
	Shenandoah Valley	0.211	0.41	0	1
	Central Virginia	0.247	0.43	0	1
	Northern Virginia	0.256	0.44	0	1
	Chesapeake Bay	0.004	0.07	0	1
	Hampton Region	0.130	0.34	0	1
	Eastern Shore	0.027	0.16	0	1
within 20 miles of:	Washington DC	0.166	0.37	0	1
	Richmond	0.152	0.36	0	1
	Appalachian Trail	0.417	0.49	0	1
	Public Beach	0.215	0.41	0	1
located in a Census Urban Area		0.807	0.40	0	1

[a] Note: Information on green certification is from the VDEQ green lodging program (http://www.deq.virginia.gov/p2/virginiagreen). Information on hotel room rates and all other amenities come from the "Hotel-Guides" search engine during July, 2008 (http://hotel-guides.us/virginia/va-hotels.html).

Table 3. Coefficients (Std Errors) for Models of Hotel Room Pricing [a]

Variable	[1]		[2]		[3]		[4]	
green certification	22.82**	(9.73)	17.09**	(8.64)	18.78**	(8.72)	19.16**	(7.94)
star2	20.89***	(5.79)	11.75*	(6.00)	7.87	(6.11)	6.49	(6.21)
star3	35.74***	(6.73)	18.77**	(7.45)	9.6	(8.43)	7.21	(8.19)
star4	87.72***	(13.05)	82.70***	(13.86)	69.31***	(14.95)	60.01***	(14.60)
# rooms	0.13***	(0.04)	0.08*	(0.04)	0.07	(0.05)	0.03	(0.05)
# floors			1.17	(0.84)	0.83	(0.84)	-0.18	(1.14)
motel			-5.15	(7.40)	-0.04	(7.27)	0.96	(6.10)
resort			-13.90*	(7.75)	-10.44	(7.65)	-5.22	(8.04)
smoke free			17.03**	(8.51)	10.67	(9.86)	5.61	(9.24)
all suites			31.20***	(9.14)	31.52***	(9.84)	26.59***	(9.03)
kitchenette			5.75	(5.53)	3.67	(5.97)	-2.02	(5.99)
pets allowed			-13.28***	(4.57)	-12.55***	(4.60)	-13.69***	(4.85)
convention			9.84**	(4.33)	4.66	(4.49)	4.94	(4.03)
breakfast					2.42	(5.35)	3.75	(4.97)
dining					8.71	(5.82)	7.02	(5.61)
free internet (lobby)					-1.57	(4.41)	-0.37	(4.38)
internet (room)					10.06*	(5.29)	12.17**	(4.77)
business center					5.61	(5.11)	5.59	(5.03)
pool					0.3	(4.45)	2.42	(4.88)
fitness center					10.86**	(4.54)	11.73***	(4.24)
tennis court					-0.9	(8.76)	-7.92	(8.71)
golf					-4.86	(4.75)	1.07	(4.48)
jacuzzi					5.61	(6.06)	9.84*	(5.69)
Heart of Appalachia							14.72	(10.41)
Shenandoah Valley							17.23*	(8.74)
Central Virginia							22.85**	(9.58)
Northern Virginia							33.11**	(13.00)
Chesapeake Bay							124.27***	(22.37)
Hampton Region							0.07	(23.35)
Eastern Shore							26.51**	(13.18)
Census Urban Area							-0.91	(5.18)
Washington DC							36.89**	(16.99)
Richmond							5.06	(9.71)
App. Trail							13.81	(11.31)
Beach							42.64*	(22.58)
Wash. DC * distance							-0.51	(0.60)
Richmond * distance							-0.87	(0.60)
App. Trail * distance							-0.4	(0.50)
Beach * distance							-2.41**	(1.09)
constant	52.70***	(4.91)	59.88***	(6.94)	55.40***	(8.26)	31.74**	(13.60)
R^2	0.41		0.54		0.58		0.68	
N	223		223		223		223	

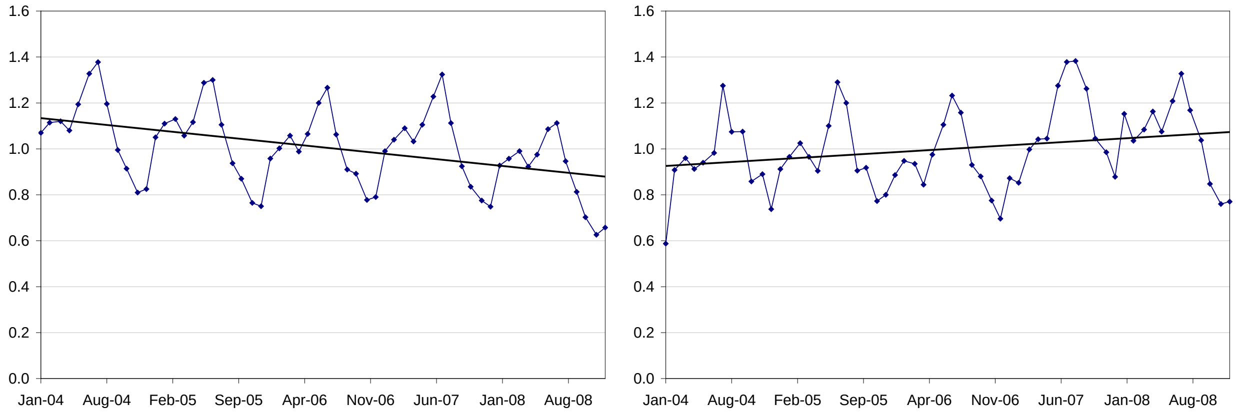
[a] Note: The table reports robust standard errors, where * p<0.1; ** p<0.05; *** p<0.01. All variables are summarized in table 2 except for the last four distance interactions. These variables are defined by multiplying the linear distance (in 1000 meters) to each amenity by an indicator for being located within 20 miles of the amenity. The excluded tourism region is the Blue Ridge Highlands.

Table 4. Meta-Analysis of Alternative Model Specifications [a]

Variable	[1] OLS		[2] Probit	
# floors	-0.1766***	(0.013)	-0.1685***	(0.048)
motel	-0.0574***	(0.013)	-0.2147***	(0.046)
resort	-0.5399***	(0.013)	-0.6795***	(0.046)
smoke free	-4.3563***	(0.015)	-7.2341***	(0.194)
all suites	0.1814***	(0.013)	1.5785***	(0.047)
kitchenette	0.4520***	(0.014)	0.3383***	(0.044)
pets allowed	-0.2233***	(0.012)	0.9006***	(0.048)
convention	0.3593***	(0.013)	0.7802***	(0.046)
breakfast	-0.0415***	(0.013)	0.0109	(0.044)
dining	0.0220*	(0.013)	-0.1112**	(0.045)
free internet (lobby)	0.1136***	(0.013)	0.1931***	(0.044)
internet (room)	1.8228***	(0.013)	3.5940***	(0.067)
business center	-0.2032***	(0.013)	-0.0551	(0.044)
pool	0.1821***	(0.013)	-0.0286	(0.045)
fitness center	0.0567***	(0.012)	1.2438***	(0.049)
tennis court	0.4990***	(0.014)	-0.2338***	(0.047)
golf	-0.1618***	(0.013)	-0.0866*	(0.046)
jacuzzi	-1.0053***	(0.013)	-1.0306***	(0.048)
spatial fixed effects	-5.3758***	(0.011)	-5.0400***	(0.093)
dep. var. = log(price)	-0.6274***	(0.011)	0.0013	(0.036)
constant	21.7390***	(0.015)	8.3960***	(0.198)
R^2 or Pseudo R^2	0.9123		0.8064	
N	40,000		40,000	

[a] Note: the table reports robust standard errors where * p<0.1; ** p<0.05; *** p<0.01. All 40,000 regressions included the “basic” set of covariates (green certification, star rating dummies, and the number of rooms).

Figure 1. Google Search Volume Indices for Key Words Related to Green Lodging [a]

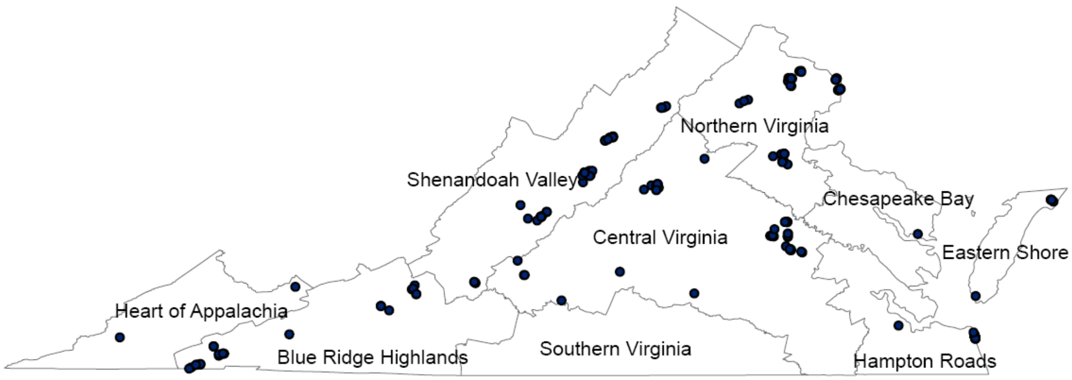


A. Search volume for "hotels"

B. Search volume for "green hotels"

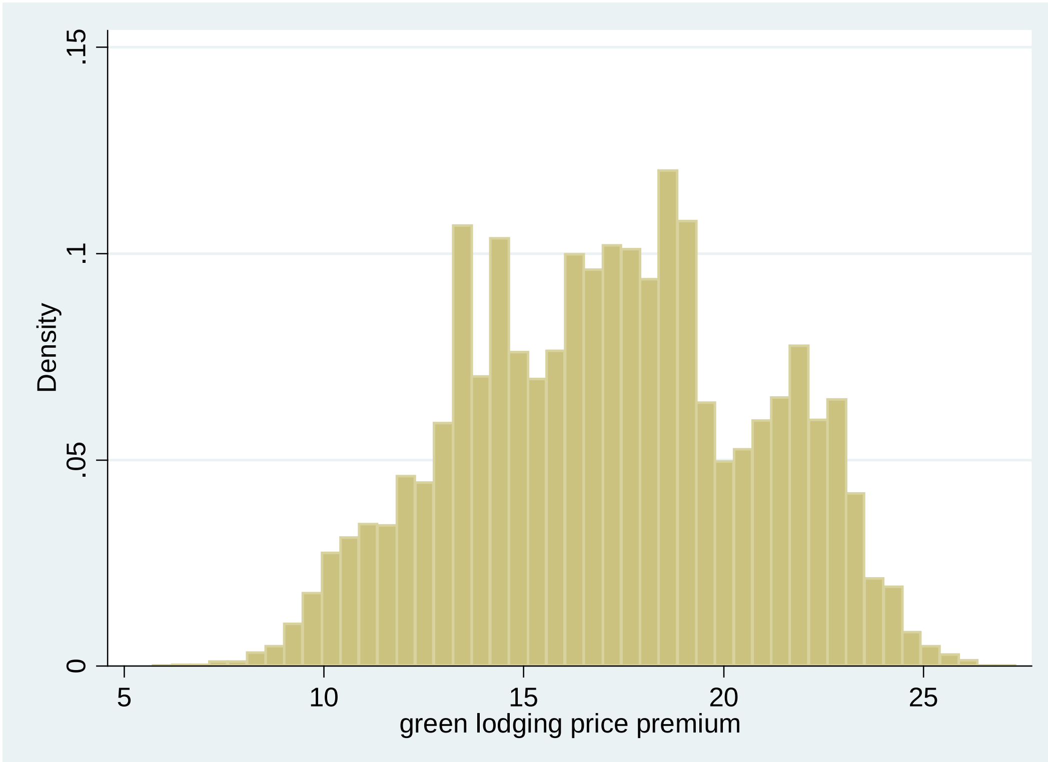
[a] Note: these indices reflect monthly Google search volumes for the entire United States. The indices are normalized by the mean search volume for each key word from the beginning of 2004 through the end of 2008. Linear trend lines have been fitted to the search volume data for "hotels" and "green hotels".

Figure 2. Locations of 223 Hotels within Virginia's Tourism Regions [a]



[a] Note: it is often the case that several hotels are located too close together to distinguish them on the map. As a result, a single dot often represents two or more hotels.

Figure 3. Distribution of Estimates for the Green Lodging Price Premium [a]



[a] Note: this figure displays the distribution of 40,000 estimates for the green lodging price premium used in the internal meta-analysis.