

Green premiums: assessing the revenue impact of eco-certification in the hospitality sector

Antonio Arbelo, Marta Arbelo-Pérez and Violeta De Vera
*Department of Business Management, IUDE, Universidad de La Laguna,
San Cristóbal de La Laguna, Spain, and*

Anil Bilgihan
College of Business, Florida Atlantic University, Boca Raton, Florida, USA

Abstract

Purpose – Although eco-certification is a valuable tool for the hotel industry in its pursuit of environmentally friendly operations, the factors that influence consumers' willingness to pay a premium for such certification remain unclear. This paper aims to investigate whether eco-certification allows a hotel firm to charge a premium price that compensates for the costs involved in adopting "green" practices.

Design/methodology/approach – By using a stochastic frontier Bayesian model with random coefficients, the authors analyse the revenue efficiency of 79 hotels in the Canary Islands over the period 2010–2021.

Findings – The results reveal that eco-certification has a positive effect on revenue efficiency, supporting the hypothesis that eco-certification allows hotels to charge premium prices, although this impact is not consistent across hotels. The results suggest a positive relationship between eco-certification and revenue generation in hotel firms.

Practical implications – These insights deepen the authors' understanding of how eco-certification can bolster the economic sustainability of environmentally conscious hotel operations. In a highly competitive market, eco-certification can be a differentiating factor. Managers should leverage eco-certification to differentiate their hotels from those of their competitors, potentially capturing a niche market segment that prioritizes environmental sustainability. Although the initial costs of eco-certification may be significant, the potential for premium pricing and brand enhancement can offer substantial long-term benefits.

Originality/value – This research fills a research gap by examining how sustainable practices affect premium pricing in the hotel industry, specifically on an individual hotel basis, a perspective not extensively explored in the literature.

Keywords Eco-certification, Premium prices, Hotel industry, Bayesian approach, Heterogeneity

Paper type Research paper



1. Introduction

People's growing concern about the conservation of the planet has progressively increased in recent decades, leading to a significant impact on consumer purchase behaviours. (Paul *et al.*, 2016; Gao *et al.*, 2016; Adrita and Mohiuddin, 2020). The hotel industry is one of the sectors that has the greatest environmental impact. As a result, a growing number of hotels worldwide have undertaken multiple pro-environmental initiatives to reduce their environmental footprint and improve their image and reputation. The commitment of the hotel industry to the environment has become a key factor for tourists when deciding whether to book a hotel. In this sense, environmental conservation is an essential factor for tourists when choosing destinations and accommodations (Hillery *et al.*, 2001). Consequently, hotel firms strive to use environmentally friendly production techniques to differentiate themselves and meet consumer expectations. (Kuo *et al.*, 2022). However, as Mason (2013) noted, environmentally friendly production techniques are usually more expensive, and firms are willing to incorporate these techniques only if consumers are aware of this information. That is, if consumers do not know the "green" attributes of a product, then they may demand the product less or hesitate, for example, to pay a premium for the product (Cason and Gangadharan, 2002).

Eco-certification is a vehicle to convey to consumers that a firm has an environmentally friendly production system. It communicates the "green" attributes of goods and services to consumers (Young *et al.*, 2010; Delmas and Grant, 2014). Eco-certification provides clear information to markets about products' environmental benefits, leading to the emergence of eco-certifications for sustainable hotels.

Eco-certification is associated with higher product quality (Rondinelli and Vastag, 2000), which consumers associate with greater economic value. In addition, eco-certification allows for stronger consumer loyalty, increases the likelihood of a hotel brand being chosen and differentiates a company from its competitors (Keller, 2003). However, the effectiveness of eco-certification depends on consumers being willing to pay a premium price that compensates for the higher costs of environmentally friendly operations (Delmas and Grant, 2014).

The literature in multiple industries suggests that consumers are willing to pay a premium for goods and services produced with environmentally friendly techniques (Delmas and Grant, 2014; Gow *et al.*, 2022; Roheim *et al.*, 2011; Sogn-Grundvåg *et al.*, 2013; among others). This trend is particularly evident in the tourism industry, where several studies have shown that tourists value eco-certification and are prepared to pay higher prices for eco-certified accommodations (Chan, 2013; Dolnicar and Long, 2009; García-Pozo *et al.*, 2013; Kang *et al.*, 2012; Kuminoff *et al.*, 2010; Meleddu and Pulina, 2016; Rahman *et al.*, 2015; Sipic, 2017; Modica *et al.*, 2020; Gupta *et al.*, 2023). These investigations show that clients value eco-certification and are willing to pay a premium for eco-certified goods and services.

Studies also show that tourists prioritize location or price over eco-certification (Geerts, 2014; Manaktola and Jauhari, 2007). Hotels seek certification to improve their image but do not understand its financial benefits. Some studies suggest eco-certification has no impact on hotel revenue but it can be positive or negative depending on the hotel's characteristics and sustainability practices (Chong and Verma, 2013).

These contradictory and inconclusive results suggest that the evidence regarding actual consumer behaviours is limited (Bjørner *et al.*, 2004). Although consumers insist on their preference for green products, they are not always willing to pay a premium for "green" products and services when they do not obtain a direct benefit from their consumption (Mason, 2013), as is the case with hotel services. This situation is known in the literature as the "green gap". In general, eco-certification is more of a social benefit than a direct benefit for consumers (Buckley, 2013). The literature has insufficiently addressed heterogeneity

across hotels when estimating the average impact of eco-certification on revenue, leading to contradictory results. Hotels have unique characteristics, so the impact of eco-certification on revenue can vary.

This paper aims to investigate the link between eco-certification and premium hotel prices. We use a stochastic frontier Bayesian model with random coefficients to test the effect of eco-certification on individual hotel revenues. Revenue efficiency, defined as the distance between a firm's current revenue and the efficient revenue frontier, allows us to evaluate pricing and service choices. If an eco-certified hotel charges a premium, it should have greater revenue efficiency than other hotels. The Bayesian model estimates probability distributions for parameters, isolating the effects of individual hotels. This methodology allows us to estimate a revenue frontier for each hotel and interpret results at the hotel level.

2. Theoretical background

Eco-certification is increasingly common in the tourism industry (Bianco *et al.*, 2023). It encourages sustainable management practices. Font and Buckley (2001) highlight eco-labels' dual role: signalling sustainability to environmentally conscious consumers and providing operational improvements. Eco-certification has risen in recent decades. The tourism industry pioneered sustainable practices (Acampora *et al.*, 2022) and hotel firms invest more in environmentally friendly techniques (Singal, 2014). These techniques are expensive, but hotel firms hope to attract more tourists and charge premium prices for their services. A premium price is the extra cost offset by environmentally friendly production processes (Singh and Pandey, 2015).

Eco-certification is perceived by consumers as a symbol of a firm's commitment to environmental responsibility and positively influences purchase decisions (Han *et al.*, 2009). This perception aligns with studies by Filimonau *et al.* (2022) and Puciato *et al.* (2023), who reported a significant relationship between the willingness to pay more for eco-friendly hotels and the pro-environmental attitudes of customers.

Consumers perceive eco-certified accommodations as contributing to reducing the degree of negative environmental impact, personal well-being and a sense of satisfaction from supporting environmental conservation efforts (Font and Buckley, 2001; Prud'homme and Raymond, 2013; Kizanlikli *et al.*, 2023). This perception enhances consumers' willingness to pay a premium. For example, Qubbaj *et al.* (2023) investigated how green certificates influence consumers' decisions to book green hotels online in Saudi Arabia, the results of which show that a considerable number of consumers are willing to pay more to stay in green hotels than in other hotels, with their willingness to pay varying according to their level of environmental awareness and commitment.

Demographic factors such as age, income, education level and cultural background also influence consumers' willingness to pay for eco-certified accommodations (Damigos, 2023). In general, younger consumers, higher-income individuals and those with higher education levels are more likely to pay a premium for sustainable options than other individuals are (Straughan and Roberts, 1999; Puciato *et al.*, 2023). Additional studies have also shown that women demonstrate a greater willingness to pay more (Thomas, 2022).

Despite these preferences for eco-certified accommodations, a gap often exists between consumers' stated preferences and their actual purchase behaviours (Vermeir and Verbeke, 2006; Karlsson and Dolnicar, 2015; Alreahi *et al.*, 2023). The factors contributing to this "green gap" include the higher costs associated with eco-certification, the perceived lack of immediate personal benefits and the limited availability of certified options in the market.

The tourism and hospitality industry shows the complexity of consumer behaviour regarding eco-certification. Studies by Kuminoff *et al.* (2010), Kang *et al.* (2012) and

[González-Rodríguez et al. \(2020\)](#) reveal that tourists are willing to pay more for eco-certified hotels that adopt green practices. However, this willingness is influenced by the consumer's environmental awareness, suggesting that eco-certification alone may not justify price increases in low-awareness markets. A marketing approach is needed to educate consumers about environmental benefits.

Studies such as [Bello et al. \(2023\)](#) and [Masau and Prideaux \(2003\)](#) suggest that geographical context plays an important role in the ability of hotels to charge more for eco-certification. It is relevant to ask whether the dynamics of mass tourism in certain cities or tourist regions may influence the perceived value of certifications, which could explain why hotels in areas with higher tourism demand manage to obtain better economic results through these certifications.

[Sánchez-Ollero et al. \(2014\)](#), [Mao et al. \(2022\)](#) and [Lee et al. \(2019\)](#) suggest that environmental certification improves perceived service, customer satisfaction and economic performance, beyond just charging a premium price. Hotels should consider this when justifying higher certification rates.

Certification enhances economic performance, especially in high-end, non-chain hotels, as shown by [Mao et al. \(2022\)](#). Studies like [Damigos \(2023\)](#) and [Puciato et al. \(2023\)](#) confirm consumers are willing to pay 5% more for green hotels. [Bianco et al. \(2023\)](#) also showed eco-certification improves hotel economic performance.

In contrast, [Geerts \(2014\)](#) concluded that eco-certification is not important for tourists when booking a hotel and that, on the contrary, tourists prioritize other issues, such as location, price and quality. [Geerts \(2014\)](#) highlighted the complexity represented by the existence of multiple certifications and the difficulty for clients in determining whether a hotel has certain certifications. In this context, [Karlsson and Dolnicar \(2015\)](#), when analysing the case of Iceland, found that most tourists do not seem to be significantly influenced by eco-labels when making purchase decisions. However, these authors found a niche market characterized by older and more educated tourists that does value eco-certifications. [Spenceley \(2018\)](#) suggested that hotels usually look to obtain certifications more as a marketing strategy and to avoid negative reviews than as a mechanism through which to improve their profits. Moreover, [Manaktola and Jauhari \(2007\)](#) concluded that although clients are becoming increasingly aware of ecological practices and prefer to stay in sustainable hotels, they are not willing to pay a premium price to do so. [Chong and Verma \(2013\)](#) found that, on average, the revenue of eco-certified hotels neither increases nor decreases compared with that of non-eco-certified hotels. [Gupta et al. \(2023\)](#) reported that consumers are inclined to pay more for resorts and hotels that implement eco-friendly practices. For the above authors, although the average impact of eco-certification on revenue is neutral, it is possible that this impact is different across individual hotels depending on the heterogeneity across hotels and the markets in which they operate.

The results of studies in the hotel industry on the link between eco-certification and premium prices are limited and inconclusive, with no consensus on the real impact of eco-certification ([Zhang et al., 2014](#)). It is not clear whether the cost of consumers' willingness to pay a premium price to stay in eco-certified hotels outweighs the cost of implementing environmentally friendly production techniques. All of these factors have led some hotel firms to doubt the value of eco-labels.

These divergent findings on the link between eco-certification and premium prices may stem from various factors. Although many tourists prefer sustainable hotels, they may not be willing to pay premium prices for it, possibly because they perceive sustainable practices as inherent to standard hotel quality ([Neth, 2008](#)). This finding reveals the limited amount of real evidence of consumer behaviours. Secondly, as the way of thinking of consumers and

their final behaviours can differ greatly (Geerts, 2014; Leonidou *et al.*, 2013), the results, which are based on information collected through consumer surveys, can be questioned. Furthermore, some hotel managers declare that eco-certification is not an especially important criterion for their clients when choosing a hotel (Claver-Cortés *et al.*, 2007; Molina-Azorín *et al.*, 2009).

Studies using different methodologies may lead to incorrect results if they do not adequately capture heterogeneity across hotel firms and market diversity. The resource-based view (RBV) of the firm (Barney, 1991) states that firms within the same industry or strategic group are heterogeneous in their strategic resources. The competitive position of a firm depends on resource specialization and optimal resource use to create sustained competitive advantages and above-normal performance.

Therefore, in the RBV framework, the main source of the differences in firm performance is resource heterogeneity across firms. As in any industry, hotel firms have different internal characteristics and properties and operate in differentiated markets. As a result, the success or failure of the environmental strategies of a hotel depends on its specific knowledge, processes and market. Ignoring this heterogeneity can lead to erroneous conclusions, as individual hotels may vary significantly in their knowledge and experiences regarding eco-certification (Chong and Verma, 2013). Thus, the RBV framework explains why two hotels adopting the same eco-certification strategy may yield disparate outcomes.

In contrast, a hotel lacking these resources may not achieve similar profits, as it can face difficulties in implementing and maintaining the necessary practices for eco-certification or in adequately communicating the value of these practices to its customers. This disparity underscores the importance of resource and capability heterogeneity in the hotel industry and how it influences the effectiveness of sustainability strategies. Therefore, it is expected that some eco-certified hotels will increase their revenue and that others will decrease their revenue depending on the amount of resources they possess. If heterogeneity across hotels is ignored and the effect of eco-certification on revenue is estimated for a “hypothetical” average hotel, then the result can be an average positive or negative effect depending on the number of eco-certified hotels whose revenue increases or decreases.

A positive (negative) average effect indicates that the majority of eco-certified hotels increase (decrease) their revenue. However, this finding does not necessarily imply that we can infer the direction and intensity of the average effect for a specific hotel. This methodological problem may be one of the main reasons for the mixed results of previous studies. The use of the RBV as the theoretical framework highlights the importance of considering heterogeneity across hotels. By adopting a perspective that recognizes each hotel’s uniqueness in terms of its resources and capabilities, we can better understand why eco-certification does not affect all hotels uniformly. The RBV provides a robust framework for exploring how differences in specific resources influence outcomes in various ways.

To overcome these methodological drawbacks, following the RBV, this research uses a Bayesian stochastic frontier model with random coefficients (Tsonas, 2002), assuming that hotels are heterogeneous in terms of their strategic resources.

The above considerations and the inconclusive results motivate further efforts to investigate the nature of the relationship between eco-certification and premium prices in the hotel industry. The objective of this study is to provide empirical evidence of whether eco-certification allows individual hotels to charge a premium price that compensates for the costs of implementing environmentally friendly techniques. Building on the theoretical foundation outlined above, we now detail the methodologies used to empirically investigate the research questions posed in this study.

3. Methodology

Frontier methods have been widely used to estimate the revenue frontier in the literature (Oliveira *et al.*, 2013). In these methods, the best-practice frontier is estimated, and then, the degree of inefficiency is estimated by comparing each firm with that frontier. Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977) independently propose stochastic frontier analysis (SFA) as a method through which to estimate efficiency. This methodology, together with that of data envelopment analysis (DEA) formulated by Charnes *et al.* (1978), has been one of the most commonly used frontier estimation methods through which to measure efficiency.

The key characteristic and main advantage of SFA over DEA is that its error term (ε) is a composite. That is, $\varepsilon = v \pm \mu$, where both the inefficiency itself (μ) and random fluctuations (v) are accounted for. In this way, information on the effects of variables that are not under business control (measurement errors, choice of functional form, climate, etc.) is collected separately from that on inefficiency. Furthermore, as SFA is a parametric approach, it is based on econometric models, where the estimated parameters have known statistical properties. However, its main drawback is that it is necessary to specify a certain functional form of the optimal frontier and assume the distribution of error components (Coelli *et al.*, 2005).

The revenue frontier is associated with the economic objective of maximizing revenue for a given set of inputs and was developed by Diewert (1974) and McFadden (1978). The stochastic revenue frontier can be represented in its general form as follows:

$$y_{i,t} = f(x_{i,t}; \beta) - \mu_{i,t} + \nu_{i,t}; i = 1, \dots, N; t = 1, \dots, T \quad (1)$$

where $y_{i,t}$ is the dependent variable for firm i in period t ; $x_{i,t}$ represents the independent variables of the model; β is the vector of the parameters to be estimated; $\mu_{i,t}$ is the inefficiency term that assumes that it follows an asymmetric distribution; and $\nu_{i,t}$ is the random error of the model that collects the measurement errors of the explanatory variables, and it is assumed that it follows a symmetric distribution. The inefficiency term and random error are independent and identically distributed.

As seen in equation (1), β is fixed for all firms in the sample; thus, a single optimal frontier is considered. That is, each one of the firms is compared with this common frontier to estimate its inefficiency. Implicitly, this approach assumes that all the firms in the sample are homogeneous.

However, according to the RBV (Barney, 1991), this research considers that the hotels in the sample are heterogeneous from the point of view of strategically relevant resources. To adequately capture the heterogeneity across hotel firms and to be able to interpret the results at the hotel level, the revenue frontier is estimated via a stochastic frontier model with random coefficients. In other words, we recognize that each hotel is unique in terms of its resources.

As Chong and Verma (2013) noted, having results at the hotel level is important as the experiences of hotels with pro-environmental strategies can be very different. That is, the willingness of consumers to pay a higher price may vary among different hotels depending on the level, type and environmental policy of each hotel and the peculiarities among consumers (Kang *et al.*, 2012). This situation can cause the form and positive (or negative) effect of eco-certification on revenue to be unevenly distributed among hotels, which depends on multiple factors, which are specific to each hotel and to the market in which it operates. This situation highlights the importance of considering each hotel's unique circumstances.

Tsionas (2002) offers a model of random coefficients, where β varies across firms, collecting the heterogeneity across hotels in the sample since a revenue frontier is estimated for each hotel such that:

$$y_{i,t} = f(x_{i,t}; \beta_i) - \mu_{i,t} + \nu_{i,t}; i = 1, \dots, N; t = 1, \dots, T \quad (2)$$

In this model, inefficiency $\mu_{i,t}$ is estimated by considering each hotel with respect to its own revenue frontier and not with respect to a common frontier for all hotels, which means that each hotel is evaluated against its own potential, acknowledging its individual strengths and weaknesses.

The primary objective of this research is to ascertain whether eco-certified hotels can charge a premium price that compensates for the costs of implementing environmentally friendly techniques. For this purpose, term inefficiency ($\mu_{i,t}$) depends on an explanatory variable (Z_{it}) that captures the possible differences in revenue efficiency between certified and noncertified hotels. Thus, we define term inefficiency ($\mu_{i,t}$) as follows:

$$u_{it} \sim \text{Exp}(\lambda_{it}); \lambda_{it} = \exp(\gamma_0 + \gamma Z_{it}); i = 1, \dots, N; t = 1, \dots, T \quad (3)$$

where the term inefficiency ($\mu_{i,t}$) follows an exponential distribution of λ_{it} . In turn, λ_{it} depends on γ_0 , which is the intercept, and γ represents the parameter to be estimated. This setup helps us understand whether and how eco-certification impacts a hotel's revenue efficiency.

Finally, to estimate the parameters of equations (1) and (2), an appropriate method must be chosen. Traditionally, the most common estimation method is that of maximum likelihood, which is based on the estimation of confidence intervals to test the hypothesis of whether a parameter is equal to or different from zero. However, in recent years, a new method, Bayesian inference, has gained greater prominence (Zyphur and Oswald, 2015).

Bayesian inference applied to SFA was first introduced by Van den Broeck *et al.* (1994) and is gaining more prominence because of its important advantages. Firstly, Bayesian inference estimates probability distributions for each parameter instead of point estimates and confidence intervals. This approach allows us to know the probability of a parameter being greater or lesser than any value, a fundamental question for strategic management. Any firm strategy is expected to have an impact on firm performance, regardless of how small the effect is.

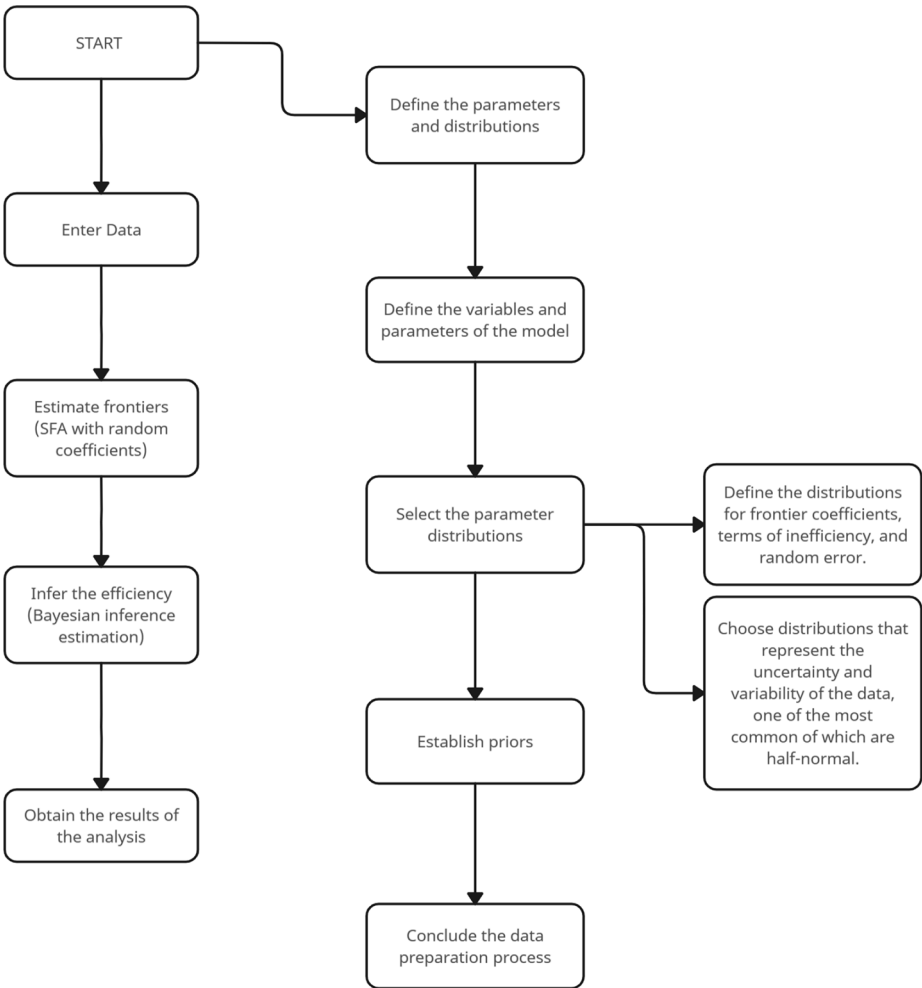
Secondly, Bayesian inference allows us to introduce prior knowledge about the parameters to be estimated into the model because it is necessary to specify their prior distributions. By incorporating previous information, the results obtained are more precise (Kruschke *et al.*, 2012; Zyphur and Oswald, 2015). Finally, the introduction to the model of prior knowledge about the parameters to be estimated facilitates the estimation of small samples, which means that Bayesian methods can work well even with limited data. In addition, Bayesian inference has greater flexibility when more complex models are estimated and different distributions are incorporated (Griffin and Steel, 2007; Kruschke *et al.*, 2012; Zyphur and Oswald, 2015). This research uses Bayesian inference as an estimation method.

The following distributions are imposed on the parameters to be estimated (Tsionas, 2002):

- β_0 follows a normal distribution of zero mean and variance 10^{-6} , such that $\beta_0 \sim N(0, 10^{-6})$.
- β_i follows a multivariate normal distribution of mean $\bar{\beta}$ and variance Ω , with Ω being an inverted Wishart distribution. In turn, $\bar{\beta}$ follows a normal distribution of zero mean and variance 10^{-6} , such that $\bar{\beta} \sim N(0, 10^{-6})$.

- The random error v_{it} follows a normal distribution of zero mean and variance σ^2 , with σ^2 being a gamma distribution of mean 10^{-3} and variance 10^{-3} , such that $\sigma^2 \sim Ga(a, b)$, with mean a/b and variance a/b^2 , respectively.
- γ_0 and γ follow an exponential distribution of parameter $r - \ln r^*$, such that $\gamma_0, \gamma \sim \text{Exp}(-\ln r^*)$, with r^* being the expected average on the basis of prior knowledge of the sector.

Figure 1 schematically represents the abovementioned methodological process.



Source(s): Created by the authors

Figure 1. Methodological process

4. Data and model specification

4.1 Data

The accounting data necessary to construct the stochastic frontier are extracted from the System of Analysis of Iberian Balances (Sistema de Análisis de Balances Ibéricos – SABI) and are used to construct the variables detailed in the following subsection. All firms that operate under category 551, “hotels and similar accommodations”, of the National Classification of Economic Activities (Clasificación Nacional de Actividades Económicas – CNAE-2009) and whose activity is carried out in the Autonomous Community of the Canary Islands, Spain, are selected. This region is selected because it is one of the main tourist destinations in Spain and, therefore, has prominent hotel offerings. In 2022, the Canary Islands received more than 17% of all tourists who entered Spain, being among the main tourist destinations of choice behind only Catalonia, with 20.73%, and the Balearic Islands, with 18.43% (INE, 2023).

Google Travel (www.google.com/travel) is used for environmental certification data. It classifies hotels based on their ecological certification. We chose Google Travel for its comprehensive and up-to-date database, which includes both eco-certified and noncertified hotels.

Hotels with the “ecological certification” label receive it from an accredited independent organization that meets specific standards. These organizations use world-renowned criteria to evaluate hotels, focusing on environmental impact in four categories: energy efficiency, water conservation, waste reduction and sustainable sourcing. These organizations must also conduct an audit of hotels’ facilities to verify their sustainability practices or use an independent third party for such verification.

Finally, after reviewing the data set and eliminating those firms that do not have data throughout the 2010–2021 study period, the resulting sample includes 79 hotels, representing 34.50% of the 229 active hotel firms in the Canary Islands. The sample includes the following diverse representations: 24.05% are three-star hotels, 41.77% are four-star hotels and the remaining 34.18% are 5-star hotels. The average number of employees among the sample firms is 282. Furthermore, 70.89% of the hotels in our sample are part of hotel chains, whereas the remaining hotels are independently operated.

Among the 79 hotel firms in the sample, 45.57% are certified hotels with environmental certifications from accredited independent organizations verifying sustainability practices in energy efficiency, water conservation, waste reduction and sustainable sourcing. The remaining 54.43% lack any environmental certifications. The sample includes 948 observations.

To avoid long-term price effects, monetary variables are deflated using the general consumer price index, with 2021 as the base year.

4.2 Model specification

The functional form used in this study is the translog function (Christensen *et al.*, 1973), which, together with the Cobb–Douglas functional form, is the most commonly used form in this type of work. To corroborate the appropriateness of this choice, we use the deviance information criterion (DIC) (Spiegelhalter *et al.*, 2002), which allows us to compare the translog model with the Cobb–Douglas model, and the model with the lower DIC value is considered the most appropriate model. In this investigation, the translog functional form obtains a lower DIC value than does the Cobb–Douglas functional form. Thus, the estimated model, imposing the restrictions of linear homogeneity in price and symmetry, is as follows:

$$\begin{aligned} \ln \left(\frac{I_{it}}{x_{6,it}} \right) = & \beta_0 + \beta_{1,i} \ln x_{1,it} + \beta_{2,i} \ln (x_{2,it}/x_{5,it}) + \beta_{3,i} \ln (x_{3,it}/x_{5,it}) + \beta_{4,i} \ln (x_{4,it}/x_{5,it}) \\ & + \frac{1}{2} \left[\beta_{5,i} (\ln x_{1,it})^2 \right] + \frac{1}{2} \left[\beta_{6,i} (\ln (x_{2,it}/x_{5,it}))^2 \right] + \beta_{7,i} \ln (x_{2,it}/x_{5,it}) \ln (x_{3,it}/x_{5,it}) \\ & + \beta_{8,i} (\ln (x_{2,it}/x_{5,it}) \ln (x_{4,it}/x_{5,it})) + \frac{1}{2} \left[\beta_{9,i} (\ln (x_{3,it}/x_{5,it}))^2 \right] \\ & + \beta_{10,i} (\ln (x_{3,it}/x_{5,it}) \ln (x_{4,it}/x_{5,it})) + \frac{1}{2} \left[\beta_{11,i} (\ln (x_{4,it}/x_{5,it}))^2 \right] \\ & + \beta_{12,i} \ln x_{1,it} \ln (x_{2,it}/x_{5,it}) + \beta_{13,i} \ln x_{1,it} \ln (x_{3,it}/x_{5,it}) \\ & + \beta_{14,i} \ln x_{1,it} \ln (x_{4,it}/x_{5,it}) + v_{it} - u_{it} \end{aligned} \quad (4)$$

$$u_{it} \sim \text{Exp}(\lambda_{it}); \lambda_{it} = \exp(\gamma_0 + \gamma Z_{it}); i = 1, \dots, N; t = 1, \dots, T$$

Following [Berger and Mester \(1997\)](#), the independent variables ($x_{i,t}$) that define the revenue frontier are the quantity of output and the price of inputs. Following the previous literature on the hotel industry, we use the following data as an approximation of the output variables and price of inputs:

Output variables: x_1 = total number of rooms.

Input price variables: x_2 = price of work (ratio of personnel costs to number of employees), x_3 = price of materials (ratio of expenses for materials to average total assets), x_4 = price of other operating expenses (ratio of other operating expenses to average total assets) and x_5 = price of capital (ratio of the depreciation of fixed assets to the total value of fixed assets).

The dependent variable of the revenue frontier is defined as operating revenue ($I_{i,t}$), which is the sum of the net amount of sales and other operating revenue.

As previously specified, term inefficiency ($\mu_{i,t}$) depends on an explanatory variable ($Z_{i,t}$) that increases in value if there are differences in efficiency between certified and noncertified hotels. Thus, we define $Z_{i,t}$ as a dummy variable that takes a value of 1 if the hotel has at least one environmental certificate and 0 otherwise. Thus, for hotels in which this parameter is positive, eco-certification leads to an increase in revenue efficiency. Conversely, for hotels whose estimated parameter is negative, eco-certification reduces revenue efficiency.

For the estimation of [equation \(4\)](#), Winbugs 14 and the Markov chain Monte Carlo (MCMC) method are used. The Gibbs algorithm introduced by [Koop et al. \(1995\)](#) is used. 50,000 interactions are generated, with the first 10,000 discarded to avoid sensitivity to initial values and ensure convergence.

[Table 1](#) displays the descriptive statistics for the variables.

5. Empirical results and discussion

[Table 2](#) presents the empirical results of estimating the revenue frontier using a Bayesian stochastic frontier model with random coefficients. These results were obtained after discarding the first 10,000 MCMC iterations to avoid sensitivity to initial values.

The values in [Table 2](#) represent the estimated parameters' means, though individual frontiers are estimated for each hotel due to the high number of coefficients. Although coefficients are not reported, significant variability exists among hotels, confirming their different revenue frontiers and heterogeneity.

Table 1. Descriptive statistics of the model variables

Variable	Symbol	Mean	SD	Min.	Max.
Operating revenue*	I	26,813.56	47,922.57	206.458	380,773.58
Number of rooms	x_1	424.380	546.548	6	3,639
Price of work*	x_2	31.098	8.187	7.761	68.078
Price of materials	x_3	0.0973	0.1445	0.00000007	1.1114
Price of other operating expenses	x_4	0.1600	0.2422	0.0049	2.0902
Price of capital	x_5	0.0487	0.0451	0.00000003	0.4888

Note(s): *In thousands of euros

Source(s): Created by the authors

Table 2. Estimation of the parameters of the revenue frontier

Parameter	Mean	Interval	
		2.50%	97.50%
β_0	12.22	11.54	12.86
β_1	-0.3665	-0.4459	-0.2697
β_2	0.4088	0.2212	0.5612
β_3	-0.0404	-0.2595	0.1359
β_4	-0.3393	-0.4658	-0.1888
β_5	-0.0069	-0.2047	0.2381
β_6	-0.1603	-0.3434	0.0730
β_7	-0.0433	-0.1130	0.0414
β_8	0.2666	-0.0006	0.4777
β_9	-0.1798	-0.4263	0.0226
β_{10}	0.4293	0.2119	0.7086
β_{11}	-0.5817	-0.7401	-0.3842
β_{12}	0.1071	-0.0958	0.2711
β_{13}	0.1512	0.0745	0.2286
β_{14}	-0.1744	-0.3804	0.0819

Source(s): Created by the authors

The average revenue efficiency of hotel firms in the sample is 71.92%, meaning that these firms waste 28.08% of their potential revenue. That is, the hotels in the sample have an average revenue of 26,813.56 thousand euros (Table 1), which could increase by 7,529.25 thousand euros if they were completely efficient. This result reveals the importance of errors (inefficiencies) on the side of outputs due to an erroneous response to the relative prices of the outputs and/or to produce a small number of high-margin services and many low-margin services.

To examine the relationship between eco-certification and premium prices, the revenue inefficiency function, together with the revenue frontier, is estimated. The results of the estimation are presented in Table 3.

The average coefficient of eco-certification in the revenue inefficiency function (Table 3) is 1.2659, revealing that, on average, the effect of eco-certification on the revenue efficiency of hotels is positive. Therefore, the incorporation of environmentally friendly production techniques that minimize or reduce the carbon footprint has a positive effect on revenue. In other words, on average, hotels that adopt environmentally friendly techniques and ensure that the environmental benefits of their services reach the market through eco-certification

Table 3. Estimation of the parameters of the inefficiency function

Variable	Symbol	Mean	SD	% > 0
Constant	γ_0	0.4222	0.0578	–
Certifications	γ	1.2659	0.8747	93.67

Source(s): Created by the authors

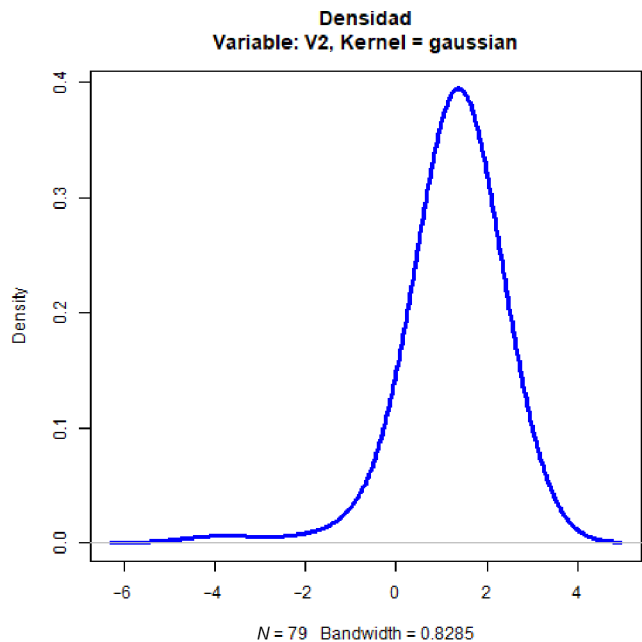
have already charged or could charge a premium price. This result corroborates consumers' willingness to pay a premium for these practices, as previously demonstrated in research (Mao *et al.*, 2022; Lee *et al.*, 2019; Bello *et al.*, 2023; Kuminoff *et al.*, 2010).

Although this result reveals that on average, eco-certified hotels can charge a premium price more easily than can non-eco-certified hotels, the objective of this research is to examine this relationship at the hotel level and not so much for a particular “hypothetical” hotel medium. One of the benefits of using Bayesian methodology in this study is that it enables us to assess the impact of a strategy at the firm level and determine the likelihood of this impact being greater or smaller than zero or any other specified value (Mackey *et al.*, 2017). This distinction is crucial when considering traditional methodologies, which only assess whether the effect is equal to or different from zero. However, in reality, the impact of a strategy on firm performance can be minuscule, even though it is highly unlikely to be zero.

Table 3 shows the probability of eco-certification positively affecting revenue efficiency. A probability greater than 50% indicates a higher likelihood of a positive effect. In this case, the probability of a positive effect is 93.67%, whereas the probability of a negative effect is 6.33%. This suggests that hotels effectively leveraging sustainability achieve greater success with eco-certification, aligning with RBV principles.

Figure 2 shows the probability distribution of the effect of eco-certification on revenue efficiency. The area under the curve to the right of zero reflects the probability of the effect of eco-certification on revenue efficiency being positive (93.67%). That is, for 74 of the 79 hotel firms in the sample, being eco-certified would allow them to charge a premium price. In contrast, the area under the curve to the left of zero indicates the probability of this effect being negative (6.33%). That is, for five of the 79 hotel firms in the sample, being eco-certified would not allow them to charge a premium price. Note also that the peak of the probability distribution curve is centred at approximately 1.4, indicating that the percentage of the most likely effect of eco-certification on revenue efficiency is 140%. These results imply that the connection between eco-certification and premium prices is not uniform across the hotels in the sample; it varies in direction and magnitude, as suggested by the RBV. Furthermore, the heterogeneity in the intensity of this relationship reveals that the magnitude of the positive (or negative) effect differs significantly across the hotels in the sample.

By considering heterogeneity, our study extends the understanding of the impact of eco-certification on revenue efficiency. It addresses the contradictory findings in the literature to provide a more nuanced view of the phenomenon. Although previous studies have treated eco-certification as a homogeneous factor that should impact all hotels similarly, our RBV-based approach suggests that the effectiveness of eco-certification largely depends on the specific resources and capabilities of each hotel. For example, hotels with superior resources, such as expert sustainability management or a specialized team, are more capable of capitalizing on the benefits of eco-certification and, therefore, achieving higher revenues. In contrast, hotels that lack these resources may not see such a significant impact, which could explain why previous studies have produced mixed results.



Source(s): Created by the authors

Figure 2. Probability distribution of the effect of eco-certification on revenue efficiency

Although some eco-certified hotels improve their image and charge a premium, others may not. This aligns with the RBV, which emphasizes the effectiveness of hotels in using their unique resources. This research introduces a framework to understand how resource and capability differences lead to divergent outcomes in implementing eco-certification strategies, enhancing the literature.

6. Conclusions

Eco-certification positively impacts hotel revenue, but its effect varies. It informs consumers about a hotel's "green" attributes. The effectiveness depends on consumers willing to pay a premium for environmentally friendly hotels. This research investigates eco-certification's effect on hotel revenue by estimating revenue efficiency in a sample of 79 Canary Islands hotels using a stochastic frontier Bayesian model with random coefficients.

Eco-certification positively impacts revenue efficiency, supporting the hypothesis that hotels can charge premium prices. It also enhances a hotel's brand image (Kim and Kim, 2022), making it a key factor in CSR strategies and increasing demand. Tourists, especially those environmentally conscious, are willing to pay premium prices for eco-certified hotels, perceiving their services as superior.

Although the dominant impact of eco-certification on the revenue of eco-certified hotels is positive, the hotel-level results of this research reveal that the sign and intensity of this effect differ across individual hotels. Therefore, when the relationship between eco-certification and premium prices is examined at the hotel level, both the positive (or negative) sign and the degree of this relationship are unevenly distributed across hotels.

This study contributes to eco-certification literature by empirically showing how resource and capability heterogeneity, as per the RBV, influences hotels' premium pricing. Although eco-certification generally boosts revenue efficiency, its impact varies across hotels due to differences in resources and capabilities. This confirms the importance of considering firm heterogeneity in sustainability strategy assessment, an overlooked aspect in previous studies.

Some hotels benefit significantly from eco-certification, as suggested by studies like [Mao et al. \(2022\)](#) and [Lee et al. \(2019\)](#), explaining why others do not achieve the same results and addressing the lack of consensus in the literature ([Zhang et al., 2014](#); [Geerts, 2014](#)).

7. Implications

7.1 Theoretical implications

These results have theoretical implications for sustainability, management, consumer behaviour and CSR. Eco-certification allows hotels to charge premium prices, indicating consumers value environmental commitments. This supports consumer behaviour theories in sustainable tourism, as [Rahman and Reynolds \(2016\)](#) found consumers' values influence willingness to pay more for green hotels. This research demonstrates that hotels with eco-certification can charge premium prices, showing consumer value directly translates into financial benefits. It reinforces the connection between consumer behaviour and hotel revenue strategies and reinforces stakeholder theory by meeting consumer and societal expectations. Eco-certification also enhances brand image and contributes to environmental economics by linking eco-friendly practices with economic benefits, boosting CSR theories by demonstrating eco-certification's strategic role in corporate sustainability.

This paper reinforces the applicability of the RBV theory by verifying the variability in the impact of eco-certification on individual hotels and its influence on revenue generation.

7.2 Managerial implications

Hotel managers should consider eco-certification as a pricing and marketing strategy, especially for environmentally conscious consumers willing to pay more for sustainability. Eco-certification differentiates hotels and enhances their brand image. Managers should promote their eco-certified status and integrate it into their CSR strategy to increase reputation and demand. However, managers should tailor eco-friendly strategies to their hotels' characteristics. The effectiveness of eco-certification in achieving premium pricing varies by market and consumer preferences.

Managers should research their target market's environmental sensitivity and tailor their offerings accordingly. Eco-certification often commands higher premiums in regions or among customer segments prioritizing sustainability. Marketing campaigns highlighting a hotel's eco-certification can resonate with environmentally conscious travellers, especially in developed markets or sustainability-focused destinations. Though initial costs are significant, eco-certification offers substantial long-term benefits, including premium pricing and brand enhancement. Thus, it can be considered a long-term investment for hotels in building their brand image and reputation.

Eco-certifications can attract specific demographics. Hotel managers can showcase these credentials effectively on digital marketing platforms, connect with the audience and communicate their values to modern consumers. Hotels can share sustainable practices on Instagram, Facebook and Twitter and engage viewers with video content on platforms like YouTube and TikTok. They can create video tours, interviews with staff or guest testimonials. Collaborating with local environmental organizations or events increases visibility and reinforces the hotel's reputation as a sustainability leader. Hotels can sponsor or participate in environmental events to network and promote their eco-certified status.

Eco-certification should be part of a broader sustainability strategy. Hotels that align their practices with certifications (e.g. visible waste reduction, energy efficiency, community engagement) gain guest trust and loyalty, leading to repeat bookings and positive word-of-mouth. Managers should invest in training to ensure employees understand and communicate the hotel's eco-certification, improving the guest experience and reinforcing its credibility.

The impact of eco-certification varies by hotel type. Luxury and chain hotels can integrate sustainability into their brand identity and operations, making eco-certifications part of a premium experience. Smaller establishments may emphasize the community impact of their sustainability practices, such as local sourcing or partnerships with environmental organizations.

Eco-certification can attract a consistent demographic of eco-conscious consumers and lead to long-term operational efficiencies, such as reduced energy costs, waste management improvements and resource conservation. Sustained commitment enhances brand reputation.

Hotel managers must address challenges like upfront costs and perceived complexity in adopting eco-certification. They can pursue incentives, partner with green technology providers and implement modular training. Marketing should highlight sustainable attributes and educate customers about benefits.

The results of this research also have broader societal implications. Widespread eco-certification in the hotel industry can significantly reduce tourism's environmental footprint by efficiently using resources, reducing waste and emissions and adopting renewable energy. This awareness among consumers can drive sustainable travel choices beyond accommodations.

8. Limitations and future research

This research has limitations. The sample only includes hotels in the Canary Islands, so results must be generalized with caution.

Future research could investigate eco-certification impacts across hotel categories and sizes, evaluating certification types and their influence on operations. Luxury hotels may see higher ROI due to sustainable clientele, whereas budget hotels may struggle due to cost prioritization. Chain hotels can leverage eco-certifications due to scale and reputation, whereas independent hotels may face resource challenges but could differentiate themselves. Research could examine these differences and consumer perceptions and decision-making processes in choosing eco-certified hotels. It could also study the long-term financial impacts of eco-certification on hotel performance.

Although this study focuses on revenue impacts, eco-certification may have broader benefits, such as enhancing brand equity, customer loyalty and employee satisfaction. Future research could explore these additional dimensions to provide a more holistic understanding of the value of eco-certification.

Despite their benefits, eco-certifications face criticism. Greenwashing research highlights consumer concerns about sustainability claim authenticity, especially in industries using eco-labels as marketing tools. This scepticism erodes trust, as consumers may perceive certifications as greenwashing attempts to attract eco-conscious guests. Future research should explore strategies like increased transparency and third-party audits to address these concerns.

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Corresponding author

Anil Bilgihan can be contacted at: abilgihan@fau.edu