



A Fusion of Climate and Cost: Effects of Climate and Price Index on Accounting-Based Performance Measurement

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Abstract

This study advanced the understanding of managerial accounting performance indicators by analyzing the joint impact of climatic variations and price indices on Spanish hotels. This analysis used a nonlinear regression framework with tensor product smooth functions to capture dynamic interactions between temperature, rainfall, and pricing decisions based on accounting frameworks. The focus of the study was to determine how these interactions affect accounting-based performance measurement across different hotel categories, from one-star to five-star. This study reveals significant nonlinear effects of climatic variables on accounting performance and observes that managerial accounting performance indicators are contingent on pricing strategies and hotel categories. Luxury hotels exhibit higher variability in fluctuations, whereas budget hotels are less affected due to their inelastic demand, influencing accounting performance metrics. Therefore, this study extended the cost management theory by integrating the accounting performance of the hospitality sector on account of the fusion of climate variability and prices across different hotel categories. This study contributes to accounting frameworks and cost management theory by linking climate and pricing effects to decision-making in accounting. The findings provide implications for accounting thought and performance measurement in sustainability contexts.

Keywords: Managerial Accounting, Cost Behavior, Performance Measurement, Accounting Theory, Sustainability Accounting

1.0 Introduction

A wide range of factors, particularly climatic conditions and pricing strategies, affect cost and performance accounting within hospitality firms. Climate variability acts as an external factor influencing accounting systems and performance. Several seminal works have shown that climatic conditions of variations in temperature and rainfall significantly influence demand for hotel services and their performance (Becken, 2013a; Gössling et al., 2012; Scott et al., 2012). Previous research has shown that favorable weather conditions attract tourists, notably in premium hotels. Conversely, adverse weather conditions reduce room occupancy (Rosselló-Nadal, 2014; Scott et al., 2019; Falk, 2013; Dogru et al., 2019). However, we need to better understand how climatic factors and hotel pricing decisions jointly affect accounting performance measurement across various categories.

Although various studies have established the relationship between climate fluctuations and the demand of tourism (e.g., Day et al., 2013; Chen & Lin, 2014; Bausch et al., 2021), our study attempted to conduct additional analysis to overcome some of the limitations of these studies. One concern is that these studies have primarily used unsuitable linear models for analyzing the non-linear fusion of climatic variables and hotel pricing in shaping accounting-based performance metrics. In a recent study, Wegelin et al. (2024)

commented that linear approaches to estimating the relationship between weather and tourist visitations are unsuitable for capturing the relationship's complexity and suggested applying better techniques. A gap in accounting theory, particularly how climate and pricing interact in accounting-based performance metrics, is critical to understanding these dynamics. Although few studies have discussed the role of prices and demand elasticity (Becken, 2013b; Rutty & Scott, 2014), this study extended the analysis exploring how economic factors and weather conditions jointly combine in a relationship to determine accounting performance across various hotel categories from budget to luxury hotels.

1.1 Our Contribution

The major contributions of this study are as follows:

First, it used a novel fusion strategy of linear and nonlinear methods to examine how climate factors, temperature, and hotel prices affect revenue per available room. This approach helped us to mitigate some of the limitations of linear models. Second, this study analyzed the effects of climate on hotel performance in different hotel categories, from one- to five-star hotels. We observed that luxury hotels are more affected by weather variations, but budget hotels exhibit relatively stable performance, possibly due to inelastic demand. This finding extended the works of Abrate et al. (2012) and

Han and Bai (2022) in observing that the effects of weather and prices differ across various hotel categories. Finally, the results highlighted the importance of adjusting pricing, marketing strategies, and investments in infrastructure based on climate and the type of hotel. In a recent study, Angelini et al. (2024) emphasized the importance of including climatic conditions in dynamic pricing models, and our study put forth it by observing that different hotel categories need different approaches. The rest of the paper is subdivided into different subsections and presented as follows: Section 2 reviews prior studies on climate variability and hotel performance dynamics pricing. Section 3 outlines the methodology employed in this study, including the data sources and the nonlinear methodology applied. Section 4 discusses results focusing on hotel performance across different hotel categories. Finally, we concluded the paper in section 5 by summarizing the findings and their implications.

2.0 Literature Review and Theoretical Accounting Context

2.1 Climatic Conditions and Tourism Hospitality Performance

Climate conditions significantly impact the tourism and hospitality industries, a phenomenon that has been well-documented. These vulnerable climate conditions also influence travel decisions, selecting destinations, and the operational stability of the tourism industry. Environmental variables are important external cost drivers that influence managerial accounting decisions, such as cost allocation and pricing strategies. This review synthesized the findings from various studies and highlighted weather and climatic change's short-term and long-term impacts on managerial performance accounting.

Foundational Concepts and Methodologies:

Earlier research established the significance of quantifying and comprehending the relationship between climate and tourism. Mieczkowski (1985) introduced the Tourism Climatic Index to assess global climates for tourism purposes. Meyer and Dewar (1999) developed tools to explore how weather numbers influence visitors, demonstrating the practical application of climatological data. Matzarakis (2006) emphasized the importance of weather and climate-related information in tourism planning and development.

Short-Term Weather and Accounting Performance Metrics:

The impact of daily and seasonal weather variations on tourism demand is an extensively studied area. Agnew and Palutikof (2006) explored the effects of short-term climate variability on tourism across the United Kingdom. Day et al. (2013) demonstrated through quantitative analysis that weather plays a crucial role in tourism performance and managerial accounting decisions. Becken (2013b) and Becken and Wilson (2013) measured the effect of weather on tourism, focusing on destination and activity-based analysis and weather impacts. Falk (2014) further explored the topic by analyzing how weather conditions influence cost-based

accounting measures. Chen and Lin (2014) inspected how weather impacts the demand for Taiwan's hotel rooms. Bausch et al. (2021) examined how weather perturbs the arrival of guests and the duration of stay across the Alpine regions. Mun and Park (2023) examined how unusual weather patterns impact the performance of these industries. Wegelin et al. (2024) put a challenge against the assumption that good weather always equates to increased visitation. Also, Zhang, D., Xie, J., & Sikveland, M. (2020) investigated how tourism seasonality impacts the financial performance of hotel firms in Norway. Ye & Xu (2021) perceived the importance of strategic management to mitigate risks associated with seasonality. Their study revealed that frequent business travel, often glamorized, has complex and multidimensional health impacts.

Climate Change and Long-Term Impacts:

The tourism industry faces profound long-term challenges from climate change. Berritella et al. (2006) used a general equilibrium analysis to study the impacts of climate change on tourism. Amelung et al. (2007) examined the implications of global climate change on tourist patterns and seasonal trends. Hamilton et al. (2005) and Bigano et al. (2006) examined the influence of climate on the choice of holiday destinations. Craig and Feng (2018) focused on climate change's temporal and spatial impacts and weather events. Fisichelli et al. (2015) forecasted changes in the visitor numbers in national parks due to rising temperatures. Dube and Nhamo (2019) highlighted the impacts on particular destinations like Victoria Falls. He et al. (2019) measured and quantified the US tourist industry's profit loss from climate change. Priego et al. (2015) used gravity-based models to evaluate the effects of climate change on domestic tourism. Rossello (2014) and Rosselló-Nadal (2014) introduced the frameworks for estimating how climate change impacts travel. Scott et al. (2019) analyzed the vulnerability of global tourism to climate change, and Scott et al. (2004) studied the climatic resource distribution across North America. González-Rodríguez, M.R., et al., (2020), studied how customers are concern about environment and their perceptions of a hotel's eco-friendly practices. Zhang and Gursoy (2021), explored consumer behavior under climate-related stressors. They also studied that how hotel's eco-friendly and climatic resilient reputation affects motivation to pay extra among the tourists.

Furthermore, Matthews, L., Scott, D., Andrey, J., Mahon, R., Trotman, A., Burrowes, R., & Charles, A. (2020). observed the influence of climate push and pull which play crucial factors in shaping tourism demand in the Caribbean. In this work they introduced optimized climate indices to predict seasonal fluctuations in tourist arrivals, focusing on destinations like Antigua and Barbuda, Barbados, and Saint Luciatto to better understand and manage seasonal tourism patterns.

Consumer Behaviours and Adaptation:

Adapting consumer behavior depends on an awareness of tourist behaviour against climate change. Gössling et al.

(2012) studied consumer behaviour and demand response to climate change. Hall et al. (2015) addressed climate change skepticism and denial in tourism. Steiger et al. (2016) examined the weather preferences of summer tourists in mountain environments. Wilkins et al. (2018) explored weather sensitivity and climate change perceptions through segmentation analysis and examined the effects of weather on tourism spending. Afshardoost et al. (2024) developed a conceptual framework for planning for weather variability. McCarroll et al. (2024) highlighted the role of tourist literacy in the weather strategies of hotel management during droughts and climate shocks. Also, Wu J. et al. (2024) proposed a hybrid decision-making model for hotel selection, integrating tourists' preferences and the perceived helpfulness of online reviews to show how tourists evaluate hotels based on a combination of personal preferences and review quality. Sainaghi, R. (2021), conducted a structured literature review to examine methodological approaches and found convergent and divergent relationships between price and revenue determinants in peer-to-peer accommodation platforms, offering insights for future research. Huber et al. (2019) in their work explored how life events shape tourism behaviour among senior citizens by employing a qualitative biographical approach for examining different life trajectories. Whereas Malichová et al. (2022) suggested that enhancing the quality and experience of sustainable modes like rail could be key to promoting a low-carbon shift in long-distance mobility and thus encouraged the ecofriendly travels.

Destination Choice and Climate Preferences:

Climate perceptions heavily influence destination choice. Bigano et al. (2006) explored the impact of climate on holiday destination choice. Eugenio-Martin and Campos-Soria (2010) examined the influence of origin climate on destination choice. Falk and Vieru (2019) explored demand in Finnish Lapland during early winter. Lise and Tol (2002) quantified the impact of climate on tourist demand. Nunes et al. (2013) performed econometric analysis on climate change impacts in Tuscany. Nakahira and Yabuta (2019) analyzed climatic and economic variables in Japan. Miao and Wei (2020), also showed hotel performance during weather-related disruptions. Rossello and Santana (2014) examined recent trends in international tourist climate preferences, updating climate change scenario projections. Scott et al. (2008) presented case studies of preferred climates in Canada, New Zealand, and Sweden. Zhang and Kulendran (2017) examined seasonal variations in Hong Kong's inbound tourism. Ridderstaat et al. (2014) analyzed seasonal climate patterns on tourism demand fluctuations in Aruba. Mckercher et al. (2015) examined the limited impacts of weather on urban destinations. Taylor and Ortiz (2009) looked at the impact of climate change on UK domestic tourism. Furthermore, Duro, J. A., & Turrión-Prats, J. (2021) spotted the differences between territorial and individual hotel seasonality, using Costa Daurada in Spain as a case study.

2.2 Dynamic Pricing Models and Climatic Conditions in Tourism:

Dynamic pricing is the mechanism that adjusts prices according to changing demand in a real-time scenario. Various factors, interruptions, and uncertain changes in market demand have become a challenging aspect of revenue management for this sector. Current research has examined incorporating climatic conditions into these dynamic pricing models to improve their performance and efficiency.

Foundational Concepts and Applications of Dynamic Pricing:

Dynamic pricing has been widely adopted in the hospitality sector. Abrate et al. (2012) provided early evidence of incorporating dynamic pricing strategies among hotels in various parts of Europe. Han and Bai (2022) conducted a comprehensive study and wrote a systematic review of dynamic pricing across this domain. Talón-Ballesteró et al. (2022) wrote "Wheel of dynamic pricing." They promoted the concept of personalized or customized pricing and their open access. Alderighi et al. (2022) showed how consumers perceive the idea of dynamic pricing and its fairness. Booking.com is one of the most accessed platforms to showcase the improvement in service and transparency. In another work, Guizzardi et al. (2022) observed the price versus quality and tried to establish a relationship between them through an online dynamic pricing system that uses temporal construal theory. Likewise, Denizci Guillet, B. (2020) explored revenue management in the hospitality industry, with a focus on understanding the key factors—such as pricing strategies, demand modelling, and external influences—that drive hotel performance. Picazo, P., & Moreno-Gil, S. (2018) quantified the impact of tour operators' marketing strategies on the pricing of sun and beach package holidays.

Integration of Climatic Conditions into Dynamic Pricing:

Many recent studies have started to incorporate climatic variables explicitly into dynamic pricing models. Angelini et al. (2024) demonstrated the direct relationship between flooding alerts and hotel prices in Venice, highlighting how climatic events can trigger dynamic pricing in real time. Thus, the tourism industry can increase opportunity by leveraging optimized pricing strategies through weather forecasts and real-time alerts. Prompt action should be taken against any sudden extreme weather conditions to keep the business running, particularly in extreme weather conditions.

Advanced Modeling and Forecasting Techniques:

The rapid growth of several innovative models expedites accurate forecasting and incorporation of climatic data. A systematic review by Henriques and Pereira (2024) shows how artificial intelligence can help incorporate and adapt climatic variables. In the work, Binesh et al. (2024) propose an artificial neural network model based on a game theory for forecasting hotel prices during turbulent times. On the other hand, Tuncay et al. (2024) propose a reinforcement learning-based dynamic pricing model to demonstrate the potential of AI in this sector. Similarly, Aydin and Birbil (2018) developed a decomposition-based method for dynamic room allocation, considering

demand shifts. Partanena and Sarkki (2021) brought new insights into tourism sustainability by examining how social innovations.

Consumer Perception and Trust in Dynamic Pricing:

As discussed above, dynamic pricing has many revenue generation and management advantages. However, there is a chance that it might impact consumer perceptions and trust negatively. Milman and Tasci (2023) and Milman et al. (2023) observed how dynamic pricing impacts consumer trust, value, and loyalty in theme parks, revealing important insights into how consumers perceive these strategies. These studies also applied to hospitality settings since climate-driven dynamic pricing can be perceived as unfair if not managed correctly. Mohammed et al. (2019) investigated last-minute hotel booking and the frequency of dynamic price adjustments in a cosmopolitan tourism city, providing empirical evidence of how rapid price changes can influence consumer behavior and how those changes are implemented. Mohsin, A., & Lengler, J. (2015) examined the impact of guests' perceived importance of hotel service dimensions on their actual experience in budget hotels and whereas Lee et al. (2023) integrated pricing strategies with external market conditions.

Demand Shifts

Long-term climate change induces significant demand shifts. Hamilton et al. (2005) simulated climate change's effect on international tourism. Amelung et al. (2007) examined climate change implications for tourism flows and seasonality. Denstadli et al. (2011) studied tourist perceptions of summer weather. Scott et al. (2012) reviewed international tourism and climate change. Nunes et al. (2013) performed econometric analysis on climate change impacts in Tuscany. Rossello (2014) and Santana (2014) provided frameworks for evaluating the effects of climate change on tourism. Fisichelli et al. (2015) predicted visitation shifts in national parks. Eugenio-Martin and Campos-Soria (2010) studied climate in origin and destination regions. Chen et al. (2017) analyzed climate factors' effect on fluctuation in tourist demand—he et al. (2019) quantified profit loss in the US hotel industry due to climate change. Wilkins et al. (2018) explored weather conditions and tourism spending. Hall et al. (2015) discussed climate change skepticism in tourism. Gössling et al. (2012) studied consumer behavior and demand response to climate change.

2.3 Nonlinear and Price-Sensitive Effects of Climatic Variability on Hotel Revenue

The preceding literature review has established climatic conditions' profound and multifaceted impacts on the

tourism hospitality industry. From foundational methodologies to consumer behavior and dynamic pricing, the prior studies highlighted the industry's vulnerability to short-term weather variability and long-term climate change. While various studies have extensively explored the relationship between climate and tourism demand, how these impacts vary across hotel star categories has not been adequately observed. Although the existing research has demonstrated the importance of dynamic pricing and adaptation strategies, it has not fully elucidated how these strategies can be tailored to mitigate the disproportionate impacts of adverse weather on different categories of hotels.

Therefore, this study aimed to fill the gaps by investigating climatic variability's nonlinear and price-sensitive effects on hotel revenue. Drawing from the existing literature and preliminary data trends, the following hypotheses were formulated:

H1: The relationship between adverse weather conditions (temperature and rainfall) and hotel revenue is nonlinear.

H2: The impact of adverse weather on REVPAR varies across different hotel categories, with higher-category hotels being more susceptible to extreme weather fluctuations.

H3: The REVPAR of budget hotels remains relatively stable regardless of adverse weather conditions due to price-inelastic demand.

3.0 Methodology

The analysis employed a theoretical accounting framework to examine how climatic variables and pricing interact to affect accounting performance measurement. The empirical illustration is based on regression models to capture these relationships.

Empirical Approach

For this study, an empirical survey-based approach is adopted to understand how financial cognition influences digital payment adoption in urban India, with a particular focus on Bangalore. Primary data is collected through structured questionnaires administered to a sample of 300–400 respondents, including students, professionals, and self-employed individuals who actively use or are aware of digital payment platforms.

3.1 Data and Variable Selection

The dependent variable in the study is REVPAR (performance indicator), which captures accounting-based performance measures. The list of variables used in the study is as follows:

Variable	Description	Unit
REVPAR	Revenue Per Available Room (performance indicator)	Euros
RAIN	Rainfall in the month	Millimeters (mm)
TEMP	Average Temperature of the month	Celsius (°C)
PINDEX	Monthly hotel price index (cost/pricing variable)	Index Value
NIGHTS	Number of nights spent by visitors in hotels	Count (in thousands)
BEDS	Total number of beds available in hotels (resource accounting measures)	Count (in thousands)

EMPL	Number of employees in the hotel (resource accounting measures)	Count (in thousands)
DAYSPG	Average number of days spent per guest in the hotel	Days

These variables collectively provide a robust framework for analyzing hotel performance in terms of operational efficiency, market conditions, and guest behavior. REVPAR is a crucial metric that reflects a hotel's ability to generate revenue from its available rooms, combining occupancy and average daily rate. This measure is widely used in the industry to assess overall performance (Abrate, Fraquelli, & Viglia, 2012). RAIN and TEMP are significant weather-related variables impacting tourism and hotel occupancy rates. Adverse weather conditions, such as heavy rainfall or extreme temperatures, can deter tourists and affect hotel performance (Bausch, Gartner, & Humpe, 2021; Becken & Wilson, 2013).

The Monthly Hotel Price Index (PINDEX) provides insights regarding the pricing trends within the hotel industry, influencing demand and revenue. Understanding competitive pricing strategies is crucial for effective revenue management (Binesh et al., 2024). BEDS are used to account for a supply measure. The NIGHTS indicates the length of stay, which is vital for understanding occupancy patterns and revenue generation (Chen & Lin, 2014). The total number of beds Available measures the hotel's capacity to accommodate guests, directly affecting its revenue potential (Aydin & Birbil, 2018).

The Number of Employees in a hotel measures its operational scale and can impact service quality and guest satisfaction. Efficient staffing is essential for maintaining high service standards (Henriques & Pereira, 2024). Lastly, the average number of days spent per guest helps understand guest behavior and preferences, which can inform marketing and operational strategies (Mun & Park, 2023). These variables collectively provide a robust framework for analyzing hotel performance, covering various aspects of operational efficiency, market conditions, and guest behavior.

3.2 Stationarity Testing

Given the time-series nature of the data, the study first tested the stationarity of each variable to ensure the appropriateness of regression analysis. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests incorporating linear trends were applied to detect unit roots. The results indicated that variables were stationary at level form and suitable for regression without further transformation.

3.3 Linear Regression Model

The study applied a linear regression model to establish a baseline relationship between hotel revenue performance and the selected climatic and control variables. The model is expressed as:

$$\begin{aligned} \text{REVPAR}_t = & \beta_0 + \beta_1 \text{RAIN}_t + \beta_2 \text{TEMP}_t + \\ & \beta_3 \text{PINDEX}_t + \beta_4 \text{NIGHTS}_t + \beta_5 \text{BEDS}_t + \beta_6 \text{EMPL}_t + \\ & \beta_7 \text{DAYSPG}_t + \\ & \varepsilon_t \end{aligned} \quad (1)$$

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Where, β_0 is Constant and $\beta_1, \beta_2, \dots, \beta_7$ are coefficients of explanatory variables, and ε_t denotes the error term.

3.4 Introducing Nonlinearity

Given the potential nonlinear influence of climatic variables on hotel revenue, the study modified the traditional linear regression by allowing smooth, nonlinear functions for certain variables while keeping others linear, as per equations 2 and 3. This nonlinear modeling approach is an extension of cost behavior theory, where nonlinearity is used to capture the dynamic and complex interaction between pricing, climatic conditions, and accounting performance.

$$\begin{aligned} \text{REVPAR}_t = & \alpha + f_1(\text{TEMP}_t, \text{PINDEX}_t) + \beta_3 \text{NIGHTS}_t \\ & + \beta_4 \text{BEDS}_t + \beta_5 \text{EMPL}_t + \beta_6 \text{DAYSPG}_t \\ & + \varepsilon_t \end{aligned}$$

$$\begin{aligned} \text{REVPAR}_t = & \alpha + f_2(\text{RAIN}_t, \text{PINDEX}_t) + \\ & \beta_3 \text{NIGHTS}_t + \beta_4 \text{BEDS}_t + \beta_5 \text{EMPL}_t + \\ & \beta_6 \text{DAYSPG}_t + \varepsilon_t \end{aligned} \quad (3)$$

Where, $f_1(\text{TEMP}_t, \text{PINDEX}_t)$ and $f_2(\text{RAIN}_t, \text{PINDEX}_t)$ are tensor product smooth functions that capture the nonlinear interaction between climatic variables (rainfall and temperature) and the hotel price index. α is constant, $\beta_1, \beta_2, \dots, \beta_7$ are coefficients of control variables, and ε_t denotes the error term.

The tensor product smooth function is defined as:

$$\begin{aligned} f_1(\text{TEMP}_t, \text{PINDEX}_t) = & \sum_{i=1}^k \sum_{j=1}^m \beta_{ij} b_i(\text{TEMP}_t) b_j(\text{PINDEX}_t) \end{aligned} \quad (4)$$

$$\begin{aligned} f_2(\text{RAIN}_t, \text{PINDEX}_t) = & \sum_{i=1}^k \sum_{j=1}^m \beta_{ij} b_i(\text{RAIN}_t) b_j(\text{PINDEX}_t) \end{aligned} \quad (5)$$

Where $b_i(\text{RAIN}_t)$ and $b_j(\text{PINDEX}_t)$ are Basis spline function for rainfall and price index; β_{ij} is the coefficient matrix for the interaction effect; k and m are the degrees of freedom for the respective variables. For computational details, refer to Hastie & Hastie (2015) and Reddy et al., 2022.

3.4 Analysis Using the effect of different types of hotels

To understand how the effect of rainfall and temperature on REVPAR varies across categories of hotels, the study segmented the data based on the accounting categories of hotels, analyzing the varying effects of climatic conditions and pricing on performance indicators across different accounting segments. The clarifications were defined as follows:

G5: (Five Star Gold Hotels)
G4: (Four Star Gold Hotels)
G3: (Three Star Gold Hotels)
G2: (Two Star Gold Hotels)
G1: (One Star Gold Hotels)

The nonlinear model was applied separately across each category, allowing the study to observe how climatic variables affect revenue differently according to the category of hotels based on their accounting performance measures.

4. Results and Discussion

The results of our study aim to examine the nonlinear effects of climatic variables on accounting performance across different price levels. It also provides interesting insights regarding how weather conditions interact with hotel price indices and, thus, how they influence overall accounting performance.

4.1 Descriptive Statistics and Correlation Analysis

Table 1. depicts the statistical summary of the key variables used in the analysis. The mean accounting performance REVPAR is 55.64 across the hotel ranges. The calculated standard deviation is 21.2. The high value of standard deviation suggests considerable variability in revenue accounting performance across hotels. Climatic variables such as temperature (TEMP) and rainfall (RAIN) exhibit moderate variability, with standard deviations of 6.22 and 31.23, respectively.

The correlation matrix in Table 2 reveals important preliminary insights. The relationship between accounting performance (REVPAR) and TEMP is positive ($r = 0.509$, $p < 0.01$), indicating that higher temperatures are generally associated with higher accounting performance. Conversely, rainfall negatively correlates with accounting performance ($r = -0.306$, $p < 0.01$), suggesting that adverse weather conditions may reduce hotel accounting performance. Moreover, the correlation between PINDEX and accounting performance ($r = 0.567$, $p < 0.01$) highlights that higher-priced hotels generate higher accounting performance.

4.2 Stationarity Tests

The stationarity of the data was confirmed through the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests presented in Table 3. All variables were found to be stationary at their levels, allowing us to proceed with regression analysis without any data transformation. The stationarity ensures that our regression results are free from spurious correlations and yield reliable estimates.

4.3 Linear Regression Results

The linear regression results for temperature and rainfall (Tables 4 and 5) revealed an insignificant direct effect of climatic variables on accounting performance. For instance, the TEMP coefficient in Table 4 is -0.124 with an insufficient p-value, indicating that temperature alone does not significantly influence accounting performance

in a linear framework. Similarly, the coefficient of RAIN in Table 5 is -0.0125, which is insignificant, confirming that rainfall has no direct linear impact on accounting performance.

However, the significant positive effect of PINDEX (coefficient = 0.334, $p < 0.01$) in the temperature model and -0.312 with p-value < 0.05 in the rainfall model suggests that prices generally generate higher accounting performance. Control variables such as NIGHTS, BEDS, EMPLOYED, and DAYSPG exhibit significant effects, consistent with prior literature on accounting performance determinants. Both models' high overall R-squared value demonstrates a reasonably good fit, although it fails to capture the complex interaction between climatic variables and hotel prices.

4.4 Nonlinear Effects of Climatic Variables on Hotel Revenue

The insignificance of climatic variables in the linear models indicated that the relationship between weather conditions and accounting performance is not purely additive but likely nonlinear. This finding justified the adoption of nonlinear models to capture the dynamic impact of climatic variables on accounting performance across different price levels. Hence, we applied a nonlinear model with tensor product smooth functions that allow interaction between climatic variables and hotel prices. The results from these models (Tables 4 and 5) demonstrated a significantly improved model fit compared to the linear regression models.

The smooth function representing the interaction between TEMP and PINDEX (Table 4) yielded an estimated degree of freedom (df) of 10.77, significantly higher than 1 (applicable in linear regression), confirming the existence of nonlinear effects. The increase in adjusted R-squared from 0.947 to 0.960, and a decrease in AIC from 717.1034 to 691.580 indicated a superior fit of the nonlinear model. This confirmed that temperature affects accounting performance differently across price levels, which linear models failed to capture.

A similar pattern emerges when examining the interaction between RAIN and PINDEX (Table 5). The smooth function for rainfall (edf = 7.376) also confirms a strong nonlinear effect, with the adjusted R-squared increasing to 0.952 and AIC decreasing to 709.069. This further supports the hypothesis that adverse weather conditions, such as rainfall, significantly nonlinearly affect accounting performance across varying classes of hotels in Spain.

4.5 Robustness of Results

The robustness of the results was confirmed through multiple approaches. First, both ADF and PP tests confirmed the stationarity of all variables, ensuring valid inferences. Second, the significantly higher *edf* values in the nonlinear models confirmed the nonlinear nature of climate-accounting performance relationships. Third, the higher adjusted R-squared and lower AIC values in the nonlinear models further validated the superior fit of nonlinear models.

4.6 REVPAR and weather influence of various categories of hotels

We also tried to find out how variations in temperature and rainfall affect the REVPER of different categories of hotels. The relationship between temperature, price index, and RevPAR is illustrated in Figure 1, revealing a non-linear interaction. Specifically, RevPAR is generally low when temperature and the price index are at lower values. The increased price index experiences a corresponding increase in REVPAR, revealing a peak within the middle range of the index. This suggests the existence of an optimal pricing window where revenue maximization is achievable. Exceeding this window results in diminishing returns. The high temperature in Q90 exhibits very high nonlinearity, wherein REVPAR decreases with an initial increase in the price index, then starts rising, and finally shows a falling trend after the price index exceeds 130. The results imply that the pricing strategies should be carefully calibrated within this mid-range to capitalize on potential revenue.

Figure 2 depicts the non-linear relations between rainfall, price index, and RevPAR hotels in Spain. Notably, RevPAR is observed to be lower when both rainfall and price index are minimal. As prices increase, RevPAR follows it, reaching a maximum within a mid-range price index, highlighting the importance of a strategic pricing approach. However, higher RevPAR values are more prevalent within this optimal price range during reduced rainfall (drier conditions). Beyond this peak, a decline in RevPAR is noted as prices continue to rise, with this effect being more pronounced during periods of high rainfall (wetter conditions). Therefore, drier conditions generally correlate with higher RevPAR, indicating that rainfall significantly impacts both the pricing strategy and the sensitivity of RevPAR to price fluctuations.

The first part of Figure 3 presents the impact of temperature variations on the RevPAR of hotels categorized by star rating. For five-star hotels (G5), RevPAR initially increases with increasing temperature but reduces later. This suggests luxury travelers prefer moderate temperatures, approximately 10 to 12 degrees Celsius, with diminishing returns at higher temperatures. However, with temperature exceeding 21 degrees Celsius, the REVPAR again increases. Four-star hotels (G4) display a similar pattern to G5, albeit with less pronounced variability. Three-star (G3) and two-star (G2) hotels maintain a relatively stable RevPAR across the temperature spectrum, with a minor dip observed in the mid-temperature range. Budget hotels (G1) exhibit the lowest overall RevPAR, with minimal fluctuations across

temperature variations, reflecting a general insensitivity to temperature changes.

Finally, the second part of Figure 3 illustrates the relationship between rainfall and RevPAR across different hotel star ratings. For five-star hotels (G5), RevPAR demonstrates a steady increase with rising rainfall, suggesting that high-end travelers maintain their preference for luxury accommodations regardless of rainy conditions. Mid-range hotels, including three-star (G3) and four-star (G4) establishments, initially display a decrease in RevPAR with increased rainfall, followed by a stabilization and a minor upward trend. Conversely, budget hotels comprising two-star (G2) and one-star (G1) maintain consistently lower RevPAR values, with minor fluctuations, suggesting that budget-conscious travelers are less sensitive to adverse weather conditions.

4.7 Results Addressing the Hypotheses

The results provided strong empirical support for the proposed hypotheses. The findings show that the nonlinear effects of climatic variables (H1) on REVPAR, as *edf* values of the interaction terms in Tables 4 and 5, are much higher than 1, confirming nonlinearity in the relationships. Regarding H2, the plots in Figures 3 and 4 show that weather affects REVPAR differently across hotel categories, where luxury hotels experience high fluctuations compared to lower-category hotels when temperature changes; however, luxury hotels find an increase in RevPAR with High rainfall as they offer better Indore amenities for the visitors. Finally, the evidence from the figures also confirms H3, as budget hotels are less affected by climatic variables, and their customer base is less weather-sensitive than high-price hotels.

5.0 Conclusion

This study examined how climatic variability and hotel prices jointly affect hotel performance, measured by accounting performance metrics. Using a nonlinear regression framework with tensor product smooth functions, this study adopted a new approach to understand the relationships better.

5.1 Study Uniqueness and Key Contributions

The main novelty of this study is that it departs from traditional linear models and compares hotel performance across different categories of hotels. Previous research often used a simple relationship between climate and revenue; this study attempted to capture the nonlinear interactions between temperature, rainfall, and hotel price indices that affect accounting performance. The study also investigated how this relationship varies across different hotel categories, from budget to luxury hotels.

5.2 New Findings and Knowledge Contribution

The study's results provide two significant insights that enhance and broaden our understanding. First, this analysis confirms the non-linear effect of climatic variables on accounting performance. It observed that weather conditions determine hotel pricing strategies. Second, this study observed heterogeneity of climate

sensitivity across different categories of hotels. Luxury hotels observe higher rate volatility due to climate variations as their customers have more discretionary power to choose accommodations. On the contrary, budget hotels have shown relatively stable accounting performance in the face of weather changes. This indicates inelastic demand from budget-conscious customers and added to our understanding of demand elasticity in the hospitality sector.

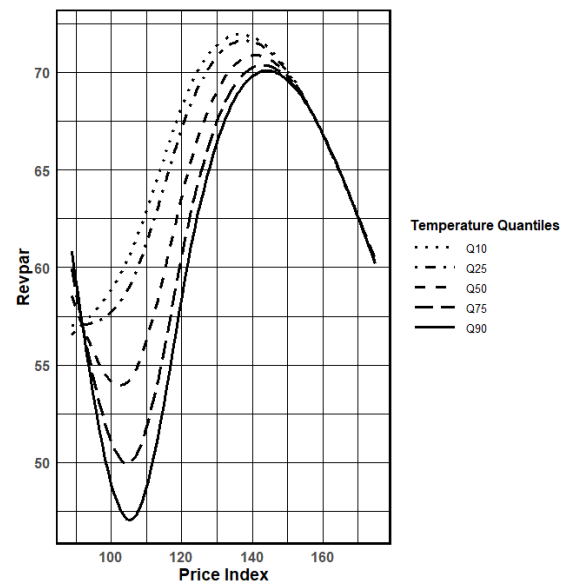
5.3 Theoretical and Practical Implications

The study has observed that weather conditions and hotel categories influence the price elasticity of demand. It provided a refined framework for understanding the accounting dynamics of hotels. On the practical front, it emphasized the adoption of climate-sensitive pricing strategies depending on the hotel category. Luxury hotels can mitigate the impact of adverse weather by relying on weather forecasting models and offering flexible pricing options. Budget hotels that are less sensitive to climatic changes should try to optimize their revenue based on their baseline demand and can apply strategic pricing during shoulder seasons. Nevertheless, the results suggest that hotels should consider developing their climate-resilient infrastructure and diversifying their indoor services to improve customer experience during adverse weather conditions.

5.4 Limitations and Scope for Further Work

Like any other study, this study also has limitations. First, the accounting model used in this study is based on monthly climatic data that may not fully capture short-term weather fluctuations that influence managerial and accounting adaptation. Future research could incorporate daily or weekly weather variations to provide more granular insights. Second, while this study focuses on Spanish hotels, findings may not be universally applicable across different geographic regions. Comparative studies across diverse climatic zones would offer a broader understanding of climate-accounting performance interactions. Finally, further research could explore the role of traveler segmentation (e.g., leisure vs. business travelers) in climate-driven demand shifts, providing more targeted insights for accounting-based strategies in revenue management. Expanding the scope to include climate adaptation strategies in accounting, such as cost management and sustainability measures, could further enrich the literature on climate resilience in the hospitality sector.

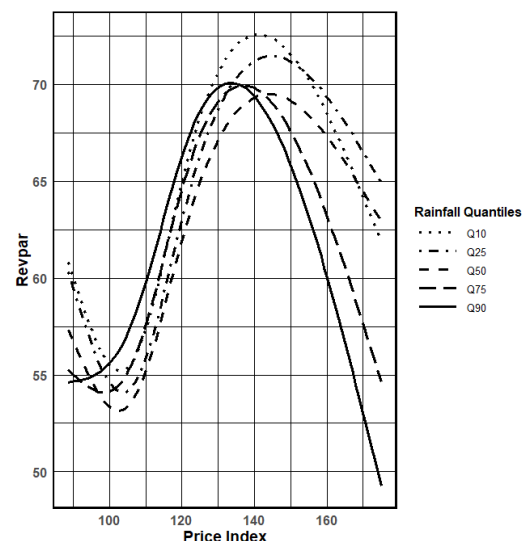
Figure 1: Joint effects of temperature and price index on RevPAR



Notes:

The plot shows how temperature and price index jointly determine RevPAR non-linearly. RevPAR is generally low when both temperature and price index are low. As prices increase, RevPAR rises, reaching its peak within the mid-range of the price index, which indicates an optimal pricing window for revenue maximization.

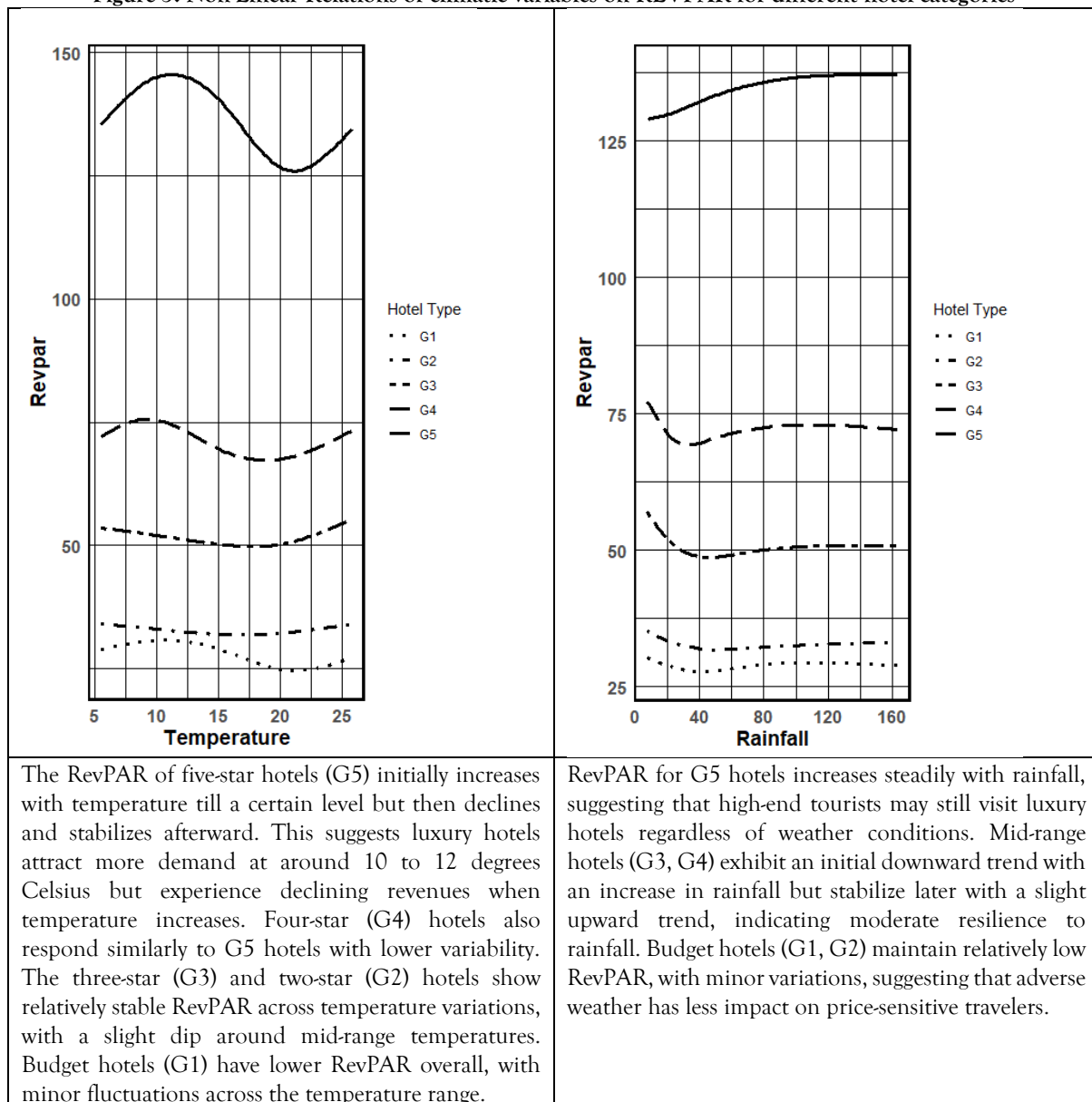
Figure 2: Joint effects of rainfall and price index on RevPAR



Notes:

The analysis reveals a non-linear relationship between rainfall, price index, and RevPAR. RevPAR generally rises as prices increase, peaking in the mid-range of the price index, indicating the need to adopt an optimal pricing strategy for maximizing revenue. High RevPAR is observed within this optimal price range during lower rainfall (drier conditions). Beyond this peak, RevPAR declines as prices continue to rise, with this decline being more pronounced during periods of higher rainfall (wetter conditions).

Figure 3: Non-Linear Relations of climatic variables on REVPAR for different hotel categories



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