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How demand uncertainty and market concentration affect long-term price instability

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ABSTRACT

The object of this paper was to investigate the long-term influences of demand uncertainty and market concentration on price instability in the hotel industry. We applied 1996–2008 price and room revenue data collected by Taiwan's Tourism Bureau to test the following two hypotheses: (1) demand uncertainty is negatively associated with price instability in the hotel industry; (2) the market concentration is negatively associated with hotel price instability. We constructed a two-stage price instability model and the estimate results produced the following two findings: First, the uncertainty in room demand significantly contributed to the price instability. Second, the effects of market structure on price instability were heterogeneous across different levels of price instability distribution. Notably, when the distribution of price instability moved from lower to higher quantiles, the relationship between market concentration and price instability altered from positive to negative.

1. Introduction

The principles of yield management suggest the hotel industry should spontaneously adjust prices to reflect the fluctuation in room demand in order to maximize profitability (Dana, 1999). Earlier studies have found that hotel managers do not adjust prices as frequently as suggested by the theory due to the additional operational and menu costs (Barro, 1972; Sheshinski and Weiss, 1977; Akerlof and Yellen, 1985; Mankiw, 1985; Rotemberg, 1982; Slade, 1991). Tisdell (1963) and Chen and Chang (2012a) have shown an increasing in price instability would leads a decrease in hotel's profit. However, it is common for today's hotel business to frequently alter their prices to reflect the changes of seasonality, competitors' price strategies, and various promotion programs. Therefore, a careful review of reasons behind hotels' price instability is important for the industry to develop better price strategies and to optimize profitability. Today, the information to assist hotel industry to correctly adjust their price in order to stay competitive and profitable is timely and extremely important, especially when the internet and electronic booking system have created more demand uncertainty and market concentration for the hotel industry.

Oi (1961) and Tisdell (1963) developed pioneering theoretical models to explain the effects of demand uncertainty on price instability and total profit. Oi compared firm profits during stable and unstable price situations and concluded that a greater variability of price would generate higher profits for the business. Tisdell (1963) focused on the supply-side and suggested that firms might suffer financial loss if they experienced maladjustment of excess supply. Although Oi and Tisdell's theoretical models are solid, we found little empirical evidence to support their arguments in the hotel industry. Moreover, market concentration has been recognized as an important factor that affects each firms' short-term demand and price variations in the short run. Indeed, if we assume hotel pricing strategy is a rational adjustment process when facing market imbalance (Qu et al., 2002), the decision to change prices is supposed to be sensitive to market concentration in the hotel industry. In other words, market prices should become less stable as competition increases (Berle and Means, 1932; Qu et al., 2002). In contrast, firms with dominating market power predictably would practice more stable prices. In the hotel economics and management literature, nevertheless, we found very limited evidence to support such a conclusion.

Chen and Chang (2012a) tested Taiwan's tourism hotel data and confirmed the impacts of demand uncertainty and market concentration on hotels' short-run profitability. However, we cannot find any empirical study in the literature focusing on how these two factors affect hotel's long run price stability and profitability. If

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we allow price instability be an indicator for hotel's profitability as suggested by previous studies, it is very important to investigate the connection between these factors (demand uncertainty and market concentration) and hotels' long-run price fluctuation. On the other hand, the inflexible supply and volatile demand of the hotel industry offer an ideal opportunity for us to test Oi and Tisdell's theories. Especially, we are interested in testing whether Oi and Tisdell's assumption that the price instability is the result of demand uncertainty is also true in the long run. Moreover, since the inflexibility supply assumption does not hold in the long run, all the findings based on short-run assumption may not hold in the long-run if firms are able to adjust factors of productions in the long run, which makes the conventional short-run analysis (i.e., fixed inputs) inadequate. Instead, we need to allow the possibility that the factors influencing price instability in the short run may not be identical in the long run. Accordingly, we proposed a price instability function and used it to estimate a long run price instability index in this study. We applied ordinary least squares (OLS) and quantile regression analyses and utilized the estimated index from the price instability function to explain the effects of demand uncertainty and market concentration on the hotel industry's long-run price instability.

2. Methodology

Based on our discussion in the previous section, we applied a two-stage empirical model to test the following two hypotheses:

Hypothesis I. Demand uncertainty is associated with hotel price instability.

Hypothesis II. Market concentration is associated with hotel price instability.

Previous studies have found the correlation between price instability and hotel's profitability (Tisdell, 1963; Chen and Chang, 2012a). Chen and Chang (2012a) also found that the connection between demand uncertainty, market concentration and hotels' short-run profitability. Therefore, this study aims to extend the previous findings and investigate whether demand uncertainty and market concentration would affect hotel's price instability in the long run, which the result can be applied for the scholars and hotel industry to develop better strategy and business plans to optimize long run profitability.

At the first stage, we generated a price instability index using the method proposed by Hunter and Coggin (1983). At the second stage, we applied the resulting price instability index, along with other dependent variables, to estimate the price instability function.

The price instability index (denoted as I) is measured as:

$$I = \frac{\sigma\sqrt{1-R^2}}{\bar{price}} \tag{1}$$

where $\bar{price}$ is the arithmetic mean of room price, σ is the standard deviation of room price, and R^2 is the coefficient of determination from the simple linear trend regression.

The hotel price instability function is:

$$Instability_i = \beta_0 + \beta_1' Mkt_i + \beta_2 Char_i + \beta_3 I_i + \varepsilon_i \tag{2}$$

Besides price instability index, Eq. (2) contained two categories of explanatory variables: market factors (*Mkt*) and hotel characteristics ($Char_i$). The market factors (*Mkt*) consist of the following three indices: the Herfindahl–Hirschman Index (denoted by *HHI*), uncertain demand for room service (denoted by *UD*), and market diversification (denoted by *Entropy*).

We calculated *HHI* by squaring the market share of each hotel that competed in the same geographical location and then summing the resulting numbers. We chose *HHI* because it allowed us to include information on all firms in the same market (Pan, 2005). Demand uncertainty was measured by using the approach proposed by Hughes and McGuire (2003). Assuming that the distribution of room demand is conditional on real demand in the past period, we applied a first-order autoregressive procedure (i.e., AR(1)) to forecast room revenue as shown in Eq. (3):

$$D_t = \alpha_0 DV_t + \alpha_1 Trend + \rho(D_{t-1} - \alpha DV_{t-1}), \tag{3}$$

where D_t is room revenue in period t, DV_t is a vector of monthly dummies, variable *Trend* denotes the time trend, and ρ represents the autocorrelations between periods. Variable *Trend* included monthly dummies and a time trend variable to control the macroeconomic factors that contributed to the changes of D_t. We then measured demand uncertainty (denoted as *UD*) by calculating the difference between the actual room revenue and predicted room revenue (i.e., the residual from Eq. (3)). A higher *UD* value indicated greater uncertainty in room demand.

Let P_r be the proportion of the r-source sales revenue to total revenues, market diversification (*Entropy*) is measured by:

$$Entropy = \sum_{r=1}^{3} P_r \ \ln\left(\frac{1}{P_r}\right) \tag{4}$$

Hotel characteristic variables ($Char_i$ in Eq. (2)) consist of operation type (*Chain*), hotel size (*Size*), location (*Metropolitan*), and the distance to the nearest airport (*Distance*). In this study, hotels have three revenue sources: food and beverage, room rates, and miscellaneous items. Table 1 summarizes the descriptive statistics of the variables included in the study.

The methodology we applied has three advantages (Kim et al., 1989): First, it does not assume either constant growth or decline in price with variability. Second, the resulting price instability index is not affected by absolute price values. Third, the component $(1-R^2)$ in Eq. (1) is associated with a growth rate line that is empirically driven in the hotel industry. We used both OLS and quantile regression analyses to estimate the coefficients of covariates in the price instability function (i.e., Eq. (2)). Eq. (5) was the regression specification of Eq. (2) for the conditional quantile:

$$Instability_i = X_i' \beta^\theta + \varepsilon_i^\theta \tag{5}$$

where β^θ is the vector of the parameters that depend on θ, X' are the explanatory variables, and ε_i^θ is the corresponding error. The quantile regression estimation was derived by minimizing the asymmetric weighted sum of absolute deviation.

Because the purpose of the study was to estimate long run price instability, we assigned each sample hotel with only one estimated value (instability index) from Eq. (5), which also indicated the conventional models designed for the panel data (for example, fixed and random effects models) were not suitable for our study. On the other hand, the quantile regression model enables us to relax the normality assumption usually required by OLS. In addition, the quantile regression model provides us more flexibility to study the complete characterization of the determinants, especially when the data showed a skewed distribution of hotel prices (especially at the higher and lower ends of the price distribution).

3. Data and study results

We used 1996–2008 price and room revenue data published by the Taiwan Tourism Bureau that was collected from monthly operation reports of 37 selected international tourist hotels in Taiwan.[2]

[2] Taiwan's government released the visa restriction for visitors from Mainland China in 2009. We decided not to include the data after 2008 to avoid potential