The Future of Corporate Hospitality and Real Estate in a Pandemic

Background and Motivation

On account of the Covid-19 global pandemic, many industries have experienced decreased demand due to stay-at-home orders and travel restrictions. The hotel industry has been especially hard-hit by the crisis, with unprecedented revenue losses, employee furloughs, and very poor occupancy projections for the near future. The current low occupancy rate shocks even dwarf those following the 9/11 crisis and the 2008 recession, with hotels currently experiencing 25% occupancy rates compared to the 65%-70% norm, a decrease of over 40-50%.[1] With profitability looking grim for the near future, a look at the industrial organization of the hotel industry could be key in motivating operating decisions and policy to aid the distressed hotel industry, until demand can return to normal levels.

Prior to the COVID-19 outbreak, the U.S. hotel industry had experienced steady growth throughout the preceding years. In 2018, the total revenues across the industry were estimated to be around $218 billion, which was an increase of $10 billion from the previous year. The largest worldwide hotel chains include Marriott International with a 2017 revenue of $22 billion, and Hilton with a revenue figure of $9.14 billion in the same year.[2] In 2015, the United States hotel industry was composed of over 54,000 properties containing 5 million rooms, with a total industry-wide real estate valuation of $725 billion. In 2014, $132 billion of the total $177 billion industry revenue originated from room revenue; this highlights the importance of room revenue as the primary determinant of hotel firms' profitability.

Industry Characteristics

The hotel industry is characterized by a few distinctive features: high barriers for entry, high fixed costs during operations, high labour intensity, and product differentiation (by virtue of a 5-star ranking system).

Firstly, the fixed costs of hotel operations will be an important aspect of the model, since these make up a majority of total hotel costs. Fixed costs come in the form of labor, room, and marketing costs, and property taxes. A breakdown of the industry fixed cost expenses in 2019 (pre-coronavirus) can be found in the appendix. Labor costs can be considered both fixed and variable in certain aspects since unoccupied rooms still need to be maintained.

Secondly, hotels display a great amount of product differentiation with respect to quality. Hotels are ranked on a five-star scale by local government tourism boards and multiple third-party

[1] "COVID-19 Devastating Hotel Industry." American Hotel & Lodging Association, 22 Apr. 2020.
[2] Sturman, Catherine. "Top 10 Biggest Hotel Chains." *Top 10*, Business Chief, 7 Sept. 2018.

ratings websites, such as Trivago and Expedia. These star ratings indicate the extra levels of amenities and luxuries that characterize the hotel, with 1 star indicating bare minimum amenities (i.e. a bed and a bathroom) while 5 stars indicate that the hotel is among the most luxurious available on the market, with accompanying luxury restaurants, spas, etc.[3] Whilst the exact boundaries and definitions can be fuzzy and vague at times, the star system does serve as a good indicator of hotel service quality. Each star level captures different types of hotel consumers, with one-star hotels capturing low-income or economic travelers and five-star hotels capturing high-income individuals. Familiar examples of different star levels of hotels include the five-star Trump Hotels, the three-star Marriott hotel chain, and the one-star Holiday Inn Express hotel chain.

It is imperative to consider the fact that different star levels of hotels experience differing levels of demand due to their 'essentiality' and risk levels throughout the COVID-19 crisis. By the definition of luxury goods, the price elasticity of demand is higher for 5-star hotels since they are easily substitutable by lower-quality hotels if prices are too high for a given demand level. Equivalently, if two star levels of hotels were offered at the same price, the consumer would prefer the higher star level one due to its extra features. Hence, it will be important to account for this effect in our model extension. On the other hand, firm entry and exit is not too important to model since we are modeling a short-term response with respect to the COVID pandemic, and given the capital-intensive nature and high economies of scale characteristic of the hotel industry, firm entry and exit is realistically much more complicated than our model would allow. Additionally, advertising is not an important factor in the demand function, as consumers under stay-at-home orders are unlikely to be sensitive to increased hotel marketing until the quarantine restrictions are lifted. A detailed breakdown of total firm costs is located in the Appendix.

Competition in the hotel industry may seem fierce. After all, there is usually little government regulation that prevents entry or government price intervention. However, within each star level in each travel destination, the market is organized rather oligopolistically or monopolistically if we look at empirical data. This oligopolistic model of the hotel industry is evidenced by a 2002 paper in Hospitality & Tourism Management by Matovic, which carries out a regression analysis on multiple hotel firm statistics such as EBITDA, relative growth, revenue share, cost barriers to entry, and number of firms.[4] Positive and significant correlations between cost barriers to entry and EBITDA, revenue share, and relative growth are found, signaling that the hotel markets are sensitive to the entry and subsequent price competition of new firms. Disregarding the prospect of firm entry, existing hotel firms of a certain star level still believe that other firms of the same star level have a high degree of influence on their own prices and market share.[5]

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[3] Bell, Amy. "Navigating The Hotel Star System." *Investopedia*, Investopedia, 31 Jan. 2020.
[4] Matovic, Dragan. "The Competitive Market Structure of the U.S. Lodging Industry and its Impact on the Financial Performance of Hotel Brands." (2002).
[5] O'Brien, Megan. "Differentiating Between Market Structures." *University of Phoenix*, 2015.

As such, to model the hotel industry effectively, it is necessary to incorporate these variables that determine the profitability of hotel firms.

Model Settings

We will use the Basic Advertising model considered in Lecture 8 as a baseline, instead modifying the advertising variable to encompass the hotel firm's star level and differing costs in the cost function. To define the model, consider the service/quality of a hotel firm, which can take any values $K \geq 1$. Define the demand function to be $Q(K,p) = Kp^{K\epsilon_p}$, with $\epsilon_p < -1$ so the function satisfies the Law of Demand, i.e. quantity is downward-sloping with respect to price at any given quality $K > 0$. Note that for a fixed elasticity level (i.e. fixed exponent), the demand function is increasing linearly in *K*. If the exponent is not fixed, then the price elasticity increases with *K* (derivations in model appendix). These are desirable properties since higher star hotels are preferred at the same price, but are easily substitutable if the price becomes relatively too expensive. The firm faces the cost function $C(q,K) = Lq + K^2q + f$ where $L > 0$ is a unit labor cost and $f > 0$ are other fixed costs. Costs are linear in *L* since empirically a 50-60% reduction in occupancy rates has resulted in a 60-70% decrease in the hotel workforce[6], so this approximately agrees with real-world changes in hotel employment. Costs are also quadratic in star level since an increment in the star level must provide much more amenities and luxuries than the level before it (i.e. the relationship between amenities/luxuries and star level is more-than-linear). Thus, the firm's total profit function is:

$$\pi(p,K) = q(K,p) * p - c(q) = Kp^{K\epsilon_p} * (p - L - K^2) - f$$

This model specification assumes that the firm is a monopolist within its own star level, for simplicity.

Model Implications

The respective first-order condition and optimality points with respect to *p* and *K* can be found in the model appendix. Solving for the optimum price shows us that the equilibrium price is increasing in *K*. This happens in part due to the monopoly markup effect, but mostly because higher quality hotels experience much higher marginal costs. However, before hotels go out and raise their luxury level in an attempt to raise prices and thus profitability, it is important to consider the interaction of *p* and *K* with quantity demanded and thus profits. The FOC for *K* ($\frac{\partial \pi}{\partial K}$) is difficult to interpret analytically, but we notice that if p is very small with $0 < p < 1$, the $log(p)$term becomes very large, so $\frac{\partial \pi}{\partial K}$becomes very negative. Hence if the market price is low enough, attempting to increase service quality (increasing K) will drive a firm into a deeper loss. In fact, our mathematical model shows that it would be profit-maximizing to offer no service quality (K=0), i.e. close down the hotel temporarily and enjoy no demand nor revenue. Intuitively, the

[6] "COVID-19 Devastating Hotel Industry." American Hotel & Lodging Association, 22 Apr. 2020.

marginal costs and losses from upgrading service quality & moving to a higher elasticity outweigh the marginal revenue from increased sales.

This is an important conclusion under the model assumptions since it might not be optimal for the firm to reduce price as a means of rebounding demand, in the event of an exogenous negative demand shock. With this in mind, the other mechanism of retaining profitability in the short term for a fixed level of K is reducing unit labor costs and fixed costs, which is our proposed strategy for the distressed hotel firms as economic consultants.

Some limitations of the model are that it assumes that a hotel firm at given quality level K is a monopolist, which does not hold in reality, since hotel markets of a particular star level are oligopolistic as earlier mentioned. Thus the derived optimal price in our model would only be an upper bound for the real optimal price in a multiple-firm setting. Analyzing data about market shares of different star level firms would allow us to incorporate oligopolistic relationships more accurately into the model. Such data could be collected from revenue shares available in hotel firm federal filings, as precise figures are not otherwise easily accessed or reported. Also, in reality K may be sticky - it may be difficult to rapidly increase or decrease a hotel's quality of service due to preexisting hardware and staffing. Still, in our model we treat it as so when we include it as a continuous choice variable to be maximized within the profit function.

Given these conclusions and limitations of the model, we would advise firms to continue searching for ways to reduce unit labor costs and fixed costs where possible, in order to salvage profitability under the low COVID quantity. Once demand returns to normal levels in the form of an exogenous demand increase post-COVID-restrictions, hotel employment will increase naturally as part of the profit maximizing endeavor. However, in the meantime firms should avoid charging very low prices in response to the demand shock, as such a decision could impact long-term profitability after the pandemic.

MODEL APPENDIX

Elasticity Computation:

$$elasticity\ of\ quantity\ w.r.t.p\ = \frac{\partial Q}{\partial p}\frac{p}{Q} = K^2\epsilon_p p^{K\epsilon_p - 1}(\frac{p}{Kp^{K\epsilon_p}}) =$$

$$K\epsilon_p p^{K\epsilon_p - 1}(\frac{1}{p^{K\epsilon_p - 1}}) = K\epsilon_p$$

First-Order Conditions:

$$\frac{\partial \pi}{\partial p} = Kp^{K\epsilon_p} + pK * K\epsilon_p p^{K\epsilon_p - 1} - LpK^2{\epsilon_p}^{K\epsilon_p - 1} - K^4\epsilon_p p^{K\epsilon_p - 1} = 0$$

$$\Rightarrow \frac{p^{K\epsilon_p}}{p^{K\epsilon_p - 1}} = p^* = \frac{LK\epsilon_p + K^3\epsilon_p}{(1 + K\epsilon_p)} = (L + K^2)(\frac{K\epsilon_p}{1 + K\epsilon_p}) = (total\ unit\ costs)(\frac{K\epsilon_p}{1 + K\epsilon_p})$$

$$\frac{\partial \pi}{\partial K} = p^{K\epsilon_p}(-\epsilon_p K log(p)(L - p + K^2) - L + p - 3K^2) = 0$$

Figure 1: Breakdown of 2019 Industry-Wide Costs and Revenues Pre-Coronavirus (in billions of dollars)

Revenues	**Costs/Expenses**
Room Fee Revenue = 165 B	Labor costs = 70 B
Food & Beverage = 39 B	Room expenses = 44 B
Other operating revenue = 8 B	Food & Beverage expenses = 29 B
Misc. income = 6 B	Administrative & General = 19 B
Total Revenues = 218 B	Marketing = 13 B
	Utilities = 7 B
	Property Taxes = 9 B
	Other Misc. Expenses = 37 B
	Total Costs = 228 B

Source: STR 2019 Hotel Operating Statistics Almanac

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