Lodging Demand for Urban Hotels in Major Metropolitan Markets

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Analyzing urban hotel properties located in major metropolitan markets during the 1989 to 2000 period, this study provides empirical evidence that various measures of current income, expectations of future income, the own price, and the price of substitutes, are statistically important factors influencing lodging demand at the property level. This study examines the relationship between lodging demand and these economic factors at the property level using a large cross section of properties and a long time horizon. The results show that income elasticities computed at the property level are significantly lower than those computed using aggregate lodging data. The results also show that the magnitude of the impact of GDP on lodging demand is similar to the magnitude of the sum of disposable personal income and corporate income. The relative magnitude of the impact of each of these economic factors on lodging demand varies across lodging market segments.

Lodging-industry professionals and analysts are concerned about the specific effects of economic factors—particularly income and prices—on hotel-room demand at the property level. Hotel investors and owners, for instance, need to know how sensitive room demand is to economic factors for hotels in a given market-price segment and location so that they can estimate the level and risk of the revenue streams for a potential hotel investment. Hotel operators need to understand the relationship between room demand and economic factors for hotels in a given market-price segment and location as a benchmark for the performance of their own properties. Operators also need to understand how sensitive their hotel's room demand is to economic factors to maximize the effectiveness of their revenue-management strategy.

As a result of the need of decision makers to understand the impact of various factors on lodging demand at the property level, the current study analyzes the impact of various economic factors on hotel room demand using property-level data for urban hotel properties located in major metropolitan markets across the United States. The economic measures are gross domestic product (GDP), disposable personal income (PI), corporate income (CI), the consumer-confidence index (CCI), the

hotel's average daily rate (ADR), and the local market's ADR (MADR). In addition, we analyze the effects across market-price segments of changes in these economic factors on room demand.

The current study makes contributions in several areas. First, our data sample consists of property-level data for 481 branded hotels in urban locations in 22 major metropolitan markets in the United States across the 48-quarter period from 1989 to 2000. Because the results are based on panel data, they are generalizable across time and across geographical locations. They are useful to urban property-level decision makers in major metropolitan markets in the United States. Furthermore, because the unit of observation is at the property level, the results are directly applicable to property-level decisions. Because of the lack of data availability, previous lodging-demand studies analyzed lodging data aggregated to the national level or aggregated to the county level for a specific state (Canter & Maher, 1998; Jogaratnam & Kwansa, 1990). These aggregate demand models estimate the income and price elasticity of demand for the overall lodging industry that is different from the income and price elasticity of demand at the property level. Instead, our analysis examines property-level sensitivities to economic factors, which is quite different from that of the aggregate lodging-demand sensitivities to economic factors. Because an individual hotel's demand is affected by a number of idiosyncratic factors, property-level demand is less sensitive to economic factors than is aggregate lodging demand. This is an important distinction because the individual-property analysis leads to an understanding of how property-level demand relates to economic measures. Rather than attempting to gauge a property's demand from overall industry statistics, property owners and operators will have a more accurate way to assess a property's operating risk.

Second, we estimate the income elasticity of demand relative to GDP, CI, disposable PI; expectations of future income, the own-price elasticity of demand; and the cross-price elasticity of demand. The impact of CI and disposable PI on lodging demand are estimated in addition to GDP, so that managers can better understand the effects of changes in these two income measures on room demand (based on their target markets). In addition, we estimate the effect of the market's current expectation of future economic conditions on current room demand to determine whether it is an important factor in explaining room demand. The magnitude of the own-price elasticity and the cross-price elasticity are important for developing pricing strategies.

Finally, it is well known that room demand is highly correlated across time and is highly correlated among competitors. The current study uses feasible generalized least squares (FGLS) to

estimate the parameters of the model using an estimate of the variance-covariance matrix that accounts for serial and crosssectional correlation and heteroscedasticity within and across properties.

The article has three sections. First, we review the pertinent literature to determine what connections other researchers have made between economic factors and lodging demand. Next, we present a discussion of the model and the data used in the current study as well as the methodology employed to study the determinants of lodging demand. Finally, we present the results of the model, estimated for the largest metropolitan markets in the United States. The model and data used focus-on-demand estimation at the property level and treat the estimates of the demand equations across properties and markets as a system. Consequently, the parameter estimates are more accurate and robust than those of previous studies and provide insights into the differences across hotel price segments to changes in the economic factors that determine room night demand.

Review of the Literature

In spite of the interest espoused by lodging industry professionals in models that estimate the impact of various factors on the demand for hotel room nights, there remain relatively few articles that have been published on the topic. Choi, Olsen, Kwansa, and Tse (1999) model the hotel industry cycle as related to the economic business cycle but focus only on the timing of the business cycle and not the underlying factors that cause changes in demand. A model presented by Coopers and Lybrand (1995) implies that the aggregate U.S. demand for hotel room nights during the past 2 decades is best modeled by a four-quarter distributed lag of GDP combined with current room rates. Wheaton and Rossoff (1998) correctly point out that using current lodging rates to explain contemporaneous room demand may create a simultaneity problem. Within the context of a system of equations that is designed to examine the cyclical behavior of the U.S. lodging industry, their explanatory model of room-night demand employs lagged GDP and room rate, as well as an adjustment term to capture the effect of lodging demand deviating from the long-run average of room demand. However, neither of these two models evaluated the influence of explanatory factors other than GDP and room rates on lodging demand. In addition, because of data restrictions, these models focus on aggregate room demand as measured by the total number of rooms sold across all U.S. markets and price points.

Factors other than own-price elasticity and income elasticity are expected to influence the demand for a service good such as lodging. Deaton and Muellbauer (1980) describe a complete model designed to consider demand for products across many markets and competitive price points. Other

researchers have explicitly considered the effects of increasing the complementary cost of a lodging stay. Fujii, Khaled, and Mak (1985) and Hiemstra and Ismail (1990, 1993) focus on the impact of increasing room taxes on lodging demand. Palakurthi and Parks (2000) evaluate the effect of selected sociodemographic factors such as gender, occupation, age, and income distribution on lodging demand. Although we do not explicitly deal with consumer demographics here, their results imply that hotels catering to different clienteles exhibit different price and income elasticities. We examine this point regarding clientele effects by analyzing the impacts of CI and disposable PI separately and by examining rooms sold by market segment.

Research focusing on forecasting international tourism demand also provides evidence regarding the importance of factors other than GDP and room rates. Kwack (1972), Summary (1987), and Witt and Martin (1987) show the influence of transportation costs on the amount spent by travelers abroad. Kim and Uysal (1998) split their sample into classes of hotels based on price points and show that the effect of prices and other factors are significantly different from each other. We show that lodging markets in the United States act similarly in that factors influencing demand for hotel room nights have different effects for different price segments.

The two articles most relevant to the current study are those by Damonte, Domke-Damonte, and Morse (1998) and Hiemstra and Ismail (1990, 1993). Hiemstra and Ismail estimated hotel demand using a cross-sectional sample of 310 properties. Factors included in that analysis as independent variables are ADR, the number of rooms available, the number of employees, revenue from food and beverage, and the percentage of guests on business, as tourists or attending conferences. They found that the price elasticity of demand varied across hotel segments' room rates. The price elasticity of demand was –.35 for low-price properties and –.57 for high-price properties. In addition, they found that the estimated parameters varied relative to a geographic market's population. The data sample used by Damonte et al. (1998) consisted of 36 monthly observations on total lodging demand for Charleston County and Columbia County in South Carolina, from December 1992 through November 1995. Two independent variables were included in their model, a quarterly dummy variable and the county average ADR. They found that the price elasticity of demand varied across the two counties in their study. Columbia County recorded a significant price elasticity of demand, of between 0.8 and 1.8, while Charleston County's price elasticity of demand was insignificant, between 0.1 and 0.3.

The current analysis expands on these two studies. Our sample consists of 481 urban properties in 22 metropolitan markets during 48 quarters. The specification of the model and estimation

techniques used in the current analysis is different from these two studies. Unlike these studies, we consider three current income measures, as well as expectations of income, ADR, and the MADR. In contrast, income was excluded from both of these studies and both of them assumed homogeneity and uncorrelated cross-sectional errors. The results found in both studies imply that different markets have different sensitivities to the determinants of demand. As a result, we focused the sample on those markets that are most likely to be homogeneous in terms of their competitive nature and sensitivity to economic factors—in this case, urban hotels in major metropolitan markets.

The Model, Data Sample, and Methodology

The Model

Economists propose a relationship between demand and wealth and income, the price of the good or service, and the price of substitutes.1 Applying basic economic principles to the demand for hotel rooms and using current income and current expectations of future income in place of wealth resulted in the following relationship:

$$\text{Rooms Sold}_{i,t} = f\left((\text{Income}_i), (\text{Expectations of future income} \mid I_t), (\text{Room Rate}_{i,t}), (\text{Room Rate of Substitutes}_{i,t})\right) \quad (1)$$

This relationship states that rooms sold at property i in quarter t is some function of current income, expectations of future income given the current information set, It, the current room rate at property i, and the current price of hotel rooms at substitutable properties for property i.[2]

Ideally, the income level of each consumer group should be included as measures of current income. The existing empirical work on lodging demand has used various measure of income. For example, Coopers and Lybrand (1995) and Wheaton and Rossoff (1998) used GDP as the income measure; Smeral (1988) and Witt and Martin (1987) used disposable personal income; Fujii et al. (1985) used total expenditure; and others such as Damonte et al. (1998) and Hiemstra and Ismail (1990) excluded measures of income or expenditure from their model. We included three measures of the current income variable in our model, namely GDP, PI, defined as disposable PI and, CI defined as corporate profits.3 A priori, it is impossible to choose the best proxy for income. In addition, the best choice of an income measure depends on the purpose of that measure's use. For example, if a manager is trying to predict lodging demand at his or her property, then it may turn out that GDP is a better

overall predictor of lodging demand than is PI and CI. However, if a manager is trying to examine the sensitivity of the property's lodg- ing demand to variations in income for specific target-market mixes, then PI and CI may be better choices than GDP, because GDP provides little information regarding the hotel's relative sensitivity to changes in corporate or leisure demand. We expect that PI will capture the hotel's sensitivity to leisure-demand generators and that CI will capture the sensitivity to business demand generators. We use the national levels of GDP, CI, and disposable PI as the appropriate measures for income driving hotel demand because it has been established that hotel demand is a function of the overall health of the economy. We chose to include these aggregate values because we believe that hotel demand is a function of the income levels of individuals and businesses outside the market because they are the ones who stay in hotel rooms.

Because economists have proposed that changes in wealth may have an impact on consumer spending, we included the CCI in the model as a proxy for current expectations of future income. The CCI is frequently used as a monitor of future economic conditions. According to The Conference Board (Consumer Research Center of the Conference Board (1989-2000), the CCI measures consumers' expectations 6 months out regarding business conditions, labor-market conditions, and income prospects.4 We include the CCI in the model to capture the impact of consumers' current expectations of future economic conditions on room demand. As expectations of future income levels increase and, likewise, consumer confidence, we expect room demand to increase as well. Theory predicts a negative relationship between the demand for a normal good and price and a positive relationship between demand and the price of substitutes. We used each hotel's ADR in the previous quarter as a proxy for the price variable and the market-average ADR in the previous quarter of all the properties in their market (MADR) as a proxy for the price of substitutes. We considered that there might be a good argument for using the competitive set's average ADR but did not have access to what competitive set each hotel was in and, therefore, could not use this measure as the price of substitutes in each market and chose to use the market average ADR as a proxy for the general price of substitutes in each market. However, because the prices of all hotels in a particular market tend to move together, we expect that the correlation between the market-average ADR of the hotels in the metropolitan statistical area (MSA) and the competitive set's average ADR is very high.

The lagged value of ADR and the lagged value of each market's MADR were used in the estimation procedure as a proxy for the room rate to avoid any simultaneity problems associated with

the relationship between ADR and rooms demanded in the same period that might arise because of the reaction of revenue management programs' responding to demand fluctuations.

Substituting the empirical measures of each of the variables described above into Equation (1) results in the following regression equation:

$$\text{Rooms Sold}_{i,t} = \beta_0 + \beta_1 * (\text{GDP or (PI and CI)}_{i,t}) + \beta_2 * (\text{CCI}_{i,t}) + \beta_3 * (\text{ADR}_{i,t-1}) + \beta_4 * (\text{MADR}_{i,t-1}) + \varepsilon_{i,t} \tag{2}$$

Data Sample

The data used in the current study came from three sources: (a) Smith Travel Research (STR), which has a database containing observations for more than 98% of the population of branded lodging properties in the United States, (b) the U.S. Bureau of Economic Analysis, and (c) The Conference Board. By arrangement with STR, we obtained monthly property-level data for 1,078 urban hotels in 25 major metropolitan markets in the United States during the 1988 to 2000 period.5 STR identifies each property's MSA and categorizes each property according to the type of location within the MSA as urban, suburban, airport, highway, and resort. We started with the top-25 markets, as designated by STR, but excluded Anaheim, California; Orlando, Florida; and Oahu, Hawaii, to maintain the homogeneity of our sample. Although they are large, these three markets are not urban markets, and the factors influencing their demand are likely to be quite different from the factors relating to the rest of the sample. After eliminating these three markets, the resulting sample contained 1,024 properties across 22 urban markets. The markets are shown in Table 1.

We have four reasons for focusing on the urban hotels in these 22 large markets. First, these markets collectively represent a substantial component of the hotel rooms in the country. Second, these hotels are considered to be the bellwethers of the hotel industry, and they are the focus of much of the industry's most costly growth activity. Third, it is inappropriate to assume that the model's parameters are constant across markets of varying size and characteristics.6 Finally, because these markets are similar, it is possible that they may be viewed as substitutes (for each other). Therefore, the cross-sectional covariance of the errors is

Table 1
Top 22 Major Metropolitan Markets

Atlanta, GA
Boston, MA
Chicago, IL
Dallas, TX
Denver, CO
Detroit, MI
Houston, TX
Los Angeles–Long Beach, CA
Miami–Hialeah, FL
Minneapolis–St. Paul, MN
Nashville, TN
New Orleans, LA
New York, NY
Norfolk–Virginia Beach, VA
Philadelphia, PA-NJ
Phoenix, AZ
San Diego, CA
San Francisco/San Mateo, CA
Seattle, WA
St. Louis, MO-IL
Tampa–St. Petersburg, FL
Washington, DC-MD-VA

nonzero, and the econometric technique employed in this analysis results in the estimation of efficient and consistent parameters. The econometric procedure used for estimating the parameters of the model requires balanced data; that is, the same times series length for each cross section. Therefore, we excluded properties that had missing values for any quarter within the 1988 through 2000 period. The final hotel property sample contains monthly observations for 481 urban properties in the 22 major metropolitan markets during 1989 to 2000. Note that data for the year 1988 were excluded from the final sample because as explained above lagged values for ADR were included in the model.

Because we used government income data that are produced each quarter, we aggregated STR's monthly rooms data to arrive at the quarterly number of rooms sold and quarterly rooms revenue for each property, i, for each quarter, t, from 1989 through 2000.We computed each property's quarterly ADR by dividing the quarterly room revenue by the quarterly rooms sold. As we indicated above, the estimation procedure employed a one-quarter-lagged value of ADR to avoid any simultaneity problems associated with the contemporaneous relationship between ADR and rooms demanded that might arise as a consequence of revenue management programs. The MADR was calculated by determining the market average ADR of all urban hotels in each metropolitan market by quarter during the sample period. We used a one-quarter-lagged value of MADR for the same reasons as we did for

ADR. Given the size and scope of the sample in the STR data set, we expect that the information

provided on lodging demand and ADR accurately reflect the total

Table 2
Summary Statistics for the Dependent and Independent Variables

	Number of Observations	M	SD
Dependent variable			
Number of rooms sold	23,088	9.53	.86
Independent variables			
CCI	23,088	4.60	.29
ADR	23,088	4.22	.48
MADR	23,088	3.94	.25
GDP (billions of dollars)	23,088	7.32	.14
CI (billions of dollars)	23,088	6.17	.20
PI (billions of dollars)	23,088	8.48	.09

Note: CCI = consumer-confidence index; ADR = average daily rate; MADR = market's average ADR; CI = corporate income; PI = personal income.
The variables have been converted to natural logs (ln). The total number of observations is 23,088. This is the product of 481 hotel properties across 48 quarters.

demand for urban hotels in major metropolitan locations in the U.S. lodging industry during the sample

period. Data during the 1989 to 2000 sample period for GDP, CI, disposable PI, the GDP deflator, and the

consumer price index (CPI) were obtained from the U.S. Department of Commerce's Bureau of the

Economic Analysis. All dollar-denominated variables except GDP were converted to 2000 dollars using

the CPI. GDP was converted to 2000 dollars using the GDP deflator. Monthly values of the CCI were

supplied by The Conference Board. Because the observational frequency in the sample is quarterly, we

used the CCI for the last month in each quarter. As a result, the CCI used in the model in quarter t

reflects consumers' expectations of income during the next 6 months. For example, for the first quarter

of a year we used the March value, which reflects consumers' expectations of economic conditions

during the April to September period. The summary statistics for the data sample are shown in Table 2.

Methodology

The demand relationship presented in Equation (2) was estimated using the log-linear functional

form so that the coefficients can be interpreted as price and income elasticities; where a given 1%

change in the price and income variables would be associated with a $\beta \times 1\%$ change in the number of

rooms sold.[7] For example, a 1% change in CI would result in a β percentage change in the total number

of rooms demanded. This results in estimates of the income elasticity of demand for each of the

measures of the income variable, the own-price elasticity of demand with respect to average ADR, and the cross-price elasticity of demand of substitutes as related to the MADR. We then subdivided the sample according to market-price segments and estimated each of the elasticities by market segment.

The parameters of Equation (2) were first estimated using GDP as the income measure, henceforth referred to as Model 1. Then, to determine whether disposable PI and CI have separate explanatory power, Equation (2) was estimated with PI and CI included in place of GDP, henceforth referred to as Model 2. Even though CI and PI are correlated, the model will be able to discriminate between them if they have separate effects on lodging demand.8 Of particular importance is determining whether these income measures are significant in the model and whether lodging demand is particularly sensitive to one or the other of them.

Finally, we tested whether the coefficients reflecting income elasticity, consumer confidence, price elasticity, and cross-price elasticity vary across different market-price segments. To accomplish this, we segmented the data into the five market-price segments provided in the STR database; namely, upper upscale, upscale, midprice with food and beverage (or full service), midprice without food and beverage (limited service), and economy. Given that consumption of lowprice goods and services represents a smaller portion of the average consumer's income than does the purchase of high-price items, we expect lodging properties in the midprice and economy markets to be less sensitive to income effects but more sensitive to own-price and cross-price effects than are upper upscale and upscale properties. Furthermore, we expect that own-price and cross-price effects will increase as we examine the progressively lower market-price segments (i.e., from upper upscale to economy).

Because the data sample consists of property-level data by quarter for the 1989 to 2000 period, modeling in these settings calls for some complex specifications because autocorrelation often appears in times-series data, and homoscedasticity and uncorrelated errors across the cross-sectional units (the properties) are strong assumptions. If we assume that the errors, $\varepsilon_{i,t,}$ in the model are not correlated cross sectionally, across hotel properties i, and not correlated across time, t, then we could simply pool the IT observations, assuming there are a total of I properties sampled and a total of T quarters per property and estimate the coefficients by ordinary least squares. Because that is not a reasonable assumption, we estimated Equation (2) using FGLS, in a fixed-effects model, to allow for the possibility of cross-sectional heteroscedasticity, cross-sectional correlation and autocorrelation, and assuming fixed effects parameter heterogeneity across properties and time.[9] For ease of discussion, suppose we have a

regression model of the form: $y_{it} = \alpha_i + \gamma_i + \beta' x_{it} + \varepsilon_{it}$, where x_{it} contains K regressors excluding the constant term. The fixed-effects approach takes αi to be a property-specific constant term and to be a time effect.10We used the F test to test the hypothesis that the constant terms are all equal across properties and time. The results indicated that the constant terms were not equal.

FGLS was used to estimate the parameters of the model because we did not assume homoscedasticity of the errors across firms and across time. If we assumed that the disturbance variance is constant within the ith group, then the White estimator (1980) that allows for heteroscedasticity of the disturbance covariance matrix across groups is appropriate. However, if the disturbance variances vary within the groups, then the White estimator of the disturbance covariance matrix may be inappropriate. Arellano (1987) proposed an estimator of the disturbance covariance matrix that also allows for nonconstant variancewithin a group. His result is a combination of the Newey and West (1987) and White (1980) estimators.

We expect that the coefficients resulting from the estimation of Equation (2) would follow established economic principles. The coefficient of the income effect is expected to be positive and significant, meaning that higher real income would have the effect of raising the demand for hotel room nights. The coefficient for CCI is expected to be positive and significant, whereby rising consumer confidence would have the effect of increasing consumer's willingness to travel and increase hotel demand. It should be noted that this effect is quite different from the income effect in that this phenomenon is the result of consumers' expectations about future economic conditions rather than of current conditions. The coefficient for ADR is expected to be negative and significant, meaning that increasing property-level ADRs are expected to have the effect of lowering the number of hotel rooms demanded. Finally, the coefficient of the cross-price substitution effect is expected to be positive and significant, whereby rising ADRs for other properties (MADR) are expected to increase the relative demand for a given property's rooms because higher room prices at other hotels reduces the consumer's sensitivity to prices at the hotel in question and render it comparatively less expensive.

Results

The results of the estimation of Equation (2) for each of the measures of income for the entire sample are presented in Table 3. The first thing to note is the stability of the coefficients across the two models. Regardless of the income measure used, the estimated parameters of the other variables are

insignificantly different across the two models. In addition, the R2s are insignificantly different from each other.[11]

The Income Measure

In each case, the coefficient on the income variable is positive and significant at the 95% level, as hypothesized. Moreover, each measure of the income elasticity is less than one—indicating relative income inelasticity for hotel demand. For example, the coefficient is .44 for GDP; that is, the coefficient smaller than one implies that the number of room nights demanded for the average urban hotel in these markets is relatively insensitive to changes in the level of GDP. We can expect by this estimate that a 1% increase in GDP would push up the number of rooms demanded at the average urban property in a major metropolitan market by 0.44%, and a 1% reduction in GDP would reduce demand by a similar amount. This result differs from those found when researchers have examined aggregate lodging demand at the national level rather than at the property level. In contrast to our findings, the income elasticity of demand was typically greater than one in the aggregate models used by prior investigators.[12] The main reason for this difference is due to the level of aggregation used in computing the values of the variables used in estimation.13

Table 3
Urban Lodging Demand in the Top 22 Major Metropolitan Markets
(Using the Fixed Effects Model)

	Model 1	Model 2
Dependent variable		
Number of rooms sold	(Equation 2 with GDP)	(Equation 2 with PI and CI)
Independent variables		
Constant	7.39	7.29
CCI	.04	.03
ADR	−.14	−.13
MADR	.08	.12
Income measures		
GDP	.44	
CI		.12
PI		.29
Number of cross sections	481	481
Times series length (quarters)	48	48
F test for no fixed effects	360.04	360.39
p value	< .0001	< .0001
R^2	.9300	.9297

Note: CCI = consumer-confidence index; ADR = average daily rate; MADR = market's average ADR; CI = corporate income; PI = personal income.
Each coefficient is significantly different from zero at the 95% confidence level.

The coefficients for CI and PI are positive and significant. The coefficient relating to the income elasticity of demand associated with personal income (0.29) is more than twice as large as the coefficient related to the income elasticity of demand associated with CI (0.12). Thus, urban lodging demand in major metropolitan markets is more than twice as sensitive to changes in personal income as it is to changes in corporate income.

The interpretation of these coefficients is that, holding everything else constant, a 1% change in personal income leads to a 0.29% change in the number of rooms demanded in the sample markets, while a 1% change in CI increases demand by a mere 0.12%. Summing these coefficients, one can conclude that the total income effect of CI and PI on lodging demand is 0.41. Because more than two thirds of the total income effect stems from changes in PI, it seems reasonable that operators and owners of hotels should pay careful attention to changes in PI, which will have a greater effect on room demand than will CI.

We hypothesize that the reason for the considerable weight of PI in our model is that it has a direct effect and an indirect effect on urban-hotel demand. The direct effect stems from the decisions of individual travelers who will purchase more hotel room nights as their income rises (and fewer as it falls). The indirect effect stems from the decisions of businesses that are counting on better (or worse) profits as their own sales increase (or decline) with changes in personal income. Those businesses will alter their travel patterns in accordance with changes in their expected future profitability and the perceived efficacy of travel for increasing future demand for business products and services.

Comparing the results of Model 2 (which examines CI and PI) with Model 1 (GDP alone), we see no significant difference in the coefficients. The sum of the CI and PI coefficients (.41) is insignificantly different from the coefficient on GDP (.44). For the sake of clarity, only the coefficients of Model 2 will be discussed in the following sections.

Price Effect

The coefficient for lagged ADR, –.13, is significant at the 95% level of confidence. The implication of this is that a 1% increase (or decrease) in the average property's ADR in these markets would have the effect of decreasing (or increasing) the number of room nights demanded by .13%. Therefore, on average, room demand is relatively inelastic with regard to ADR. This implies that revenue will not increase noticeably as a result of a price drop, holding everything else constant. However, room nights

demanded will decrease in a statistically significant manner as a property increases its ADR. This result is as expected and is in line with the estimates found by Wheaton and Rossoff (1998).

The Market-Price Substitution Effect

The coefficient for MADR, 0.12, in Model 2 is also significant at the 95% level. The implication of this result is that a 1% increase (or decrease) in the MADR will have the tendency to increase (or decrease) an average property's number of room nights demanded by 0.12%. Again, we find that a single property's demand is relatively inelastic with regard to changes in competitors' prices (as represented by the MADR). The fact that a statistically significant price-substitution effect exists is an important finding. We know of no other published research that has estimated the impact of a price-substitution effect on the demand for hotel rooms. The implication of this result is that room-nights demanded in one property are statistically related to the room rates at other hotels in the market. This means that demand models, whether designed to estimate demand for whole markets or for individual hotels, must use a pooled-time-series method similar to the one that we employed in the current analysis because demand within markets represents a system that must be estimated simultaneously.

The Impact of Consumer Confidence

The coefficient for the CCI of 0.03 for Model 2 is positive and significant at the 95% level of confidence. The implication of this result is that a 1% increase (or decrease) in the level of the CCI will increase (or decrease) the number of rooms demanded for the average urban property by 0.03%. No other work published has found a relationship between consumer confidence and room demand in the hotel industry. This finding implies that consumers will react to anticipated changes in the economic environment when making current decisions regarding where and when to travel. Therefore, hotel operators and owners may wish to factor in consumer confidence in future economic conditions along with current economic conditions when formulating their expectations for hotel demand.

Assessing the Model's Impact Across Market-Price Segments

Next, we assessed whether the parameters of Model 2 vary across price segments. To establish whether there are any variations across price segments we estimated the model for each of STR's five market-price segments.14 In particular, we are interested in determining whether there are variations across price segment in the income elasticity associated with PI and CI, and in the price and cross-price elasticity. We do expect that the sensitivity to changes in PI and CI varies across properties in different

price segments. The pattern of those variations is not simple to predict, however, due to the likely effect of two countervailing forces—those being the income effect and the trading-down(up) effect. The income effect alone suggests that diminishing income would reduce overall demand and rising income would increase overall demand. We see evidence of the so-called pure income effect in Table 3, which indicates that as income increases the demand for all hotel rooms increases. On the other hand, the trading-down(up) effect suggests that consumers may choose hotels in progressively lower price segments as income drops and that they may trade up in response to rising incomes. For example, as income increases, some consumers who previously stayed at economy hotels may trade up to midprice or to upscale properties. Thus, some low-end segments may actually see falling demand in the face of increasing incomes, owing to the trading-up effect. On the other hand, those same low-end segments might see rising demand as income diminishes and travelers trade down to lower price segment hotels. One could argue, then, that demand in the economy segment might be more sensitive to changes in income than other price segments—and in unexpected directions owing to the trading-down and trading-up effects. At the other end of the scale, we expect that the room-night demand of higher income consumers staying at upper upscale properties is relatively more insensitive to changes in income, as the cost of the hotel stay represents such a small proportion of their income. With increases in income, though, the upper upscale properties might enjoy a trading-up effect. It is possible that the trading-up and trading-down effects may offset the pure income effect in some market segments more than others.

The pure income effect and the trading-down(up) effect are expected to be stronger in low-end segments than in high-end segments. Because these are countervailing effects, we expect that the most pronounced total-income effect is likely to be among the middle three price segments, as consumers in these hotel segments are likely to be more sensitive to income shifts than are consumers in the upper upscale segment. Finally, consumers' trading-down(up) behavior will likely mean that the pure income effect would be mitigated in low-end segments. The net implications of the foregoing discussion are that the overall measure of income elasticity should be highest for properties in the upscale segment and decline as one examines properties in the midprice segments.

In general, we would expect that price and cross-price elasticity would follow a similar pattern; that is, properties in low-price segments would be more sensitive to changes in ADR than properties in high-price segments. Therefore, we should expect to find that the price elasticity is highest among the midprice and economy properties. The results of this analysis are shown in Table 4.

Table 4
Urban Lodging Demand in the Top 22 Major Metropolitan Markets
by Market Segment (Using the Fixed Effects Model)

	Upper Upscale	Upscale	Midprice Full-Service	Midprice Limited Service	Economy
Dependent variable	(1)	(2)	(3)	(4)	(5)
Number of rooms sold					
Independent variables					
Constant	7.49^a	5.84^a	5.25	6.50^a	4.70^a
CCI	$.04^a$	.01	$.05^a$	.05	.04
ADR	$-.15^a$	$-.11^a$	.01	$-.21^a$	$-.31^a$
MADR	.04	.01	.05	$.32^a$	$.44^a$
Income measures					
CI	$.09^a$	$.18^a$	$.18^a$	$.16^b$	.004
PI	$.34^a$	$.40^a$	$.24^a$	.17	.20
Number of cross sections	201	63	122	26	69
Times series length (quarters)	48	48	48	48	48
F test for no fixed effects	439.41	265.85	205.99	137.52	229.95
p value	< .0001	< .0001	< .0001	< .0001	< .0001
R^2	.9148	.8729	.8541	.7916	.8514

a. Significantly different from zero at the 95% confidence level.
b. Significantly different from zero at the 90% confidence level.

expect to find that the price elasticity is highest among the midprice and economy properties. The results of this analysis are shown in Table 4.

Table 4 shows the results for the overall sample of urban lodging properties broken down into STR's five market-price segments. The results, on average, are consistent with those reported in Table 3. However, different patterns of consumer behavior emerge when we analyze demand across segments. Overall we find that, as predicted, the impact of CI and PI on room nights demanded decreases as we move from high- to low-price segments.

Specifically, the elasticity of demand for corporate income is 0.09 in the upper upscale segment, rises to 0.19 for the upscale segment, 0.18 in the midprice with food and beverage segment, and 0.16 in the midprice without food and beverage segment with all coefficients being significant at the 95% level of confidence. We anticipated that the corporate-income elasticity would be lower for upper upscale hotels than it is for upscale properties, based on the assumption that travel by a company's president, CEO, or other highly placed corporate travelers (who would stay in top-level hotels) is not as closely related to the company's income as is travel by those outside the top echelons (who would stay in corporate-oriented upscale properties). Only the coefficient for the economy segment (0.004) is statistically insignificant from zero. That makes sense, given that business travelers' demand for hotels

in this sector is likely to be sensitive to income levels and that many business travelers will trade down to economy hotels as corporate income declines.

The results for PI follow much the same pattern as those for CI. The estimated PI elasticity of demand is 0.34 in the upper upscale segment, compared to 0.40 in the upscale segment and 0.24 in the full-service midprice segment. The results for the other segments (0.17 for limited-service midprice hotels and 0.20 for economy hotels) are not significant. Again, we anticipated that the PI elasticity would be lower for upper upscale hotels than it is for upscale properties. As we explained above, the cost of the hotel stay represents such a small fraction of the guests' income that demand for hotel nights is relatively insensitive to changes in customers' income. Of particular interest here for hotel-demand forecasters is that CI remains statistically significant to room demand in the limited-service midprice segment, whereas PI is not a significant factor. The pure income effect always occurs for the limited-service properties; however, our findings imply that the trading-down(up) phenomenon does not occur with business travelers to the extent that it does with individual or leisure travel within this price segment.

Turning to the estimated effect of changes in laggedADRroom-night demand, we find that the price elasticity becomes less pronounced as one compares upper upscale hotels to the upscale segment and then amplifies dramatically as one examines lower price segments. The price elasticity is –.15 in the upper upscale segment and –.11 in the upscale segment. The price elasticity amplifies to –.21 in the limited-service midprice segment and reaches –.31 in the economy segment. The only exception to the foregoing pattern occurs in the full-service midprice segment, where the own-price elasticity of demand is not statistically different from zero. Although this result is surprising and invites further study, the results generally indicate that room demand at hotels in the low-price segments is substantially more sensitive to changes inADRthan average and that hotels in the upper upscale segment will find their demand rising significantly more than average as they reduce their room prices. These results indicate that revenue management is likely to be most effective for hotels at the market price segment extremes and should be pursued aggressively by these properties.

The effect that changes in MADR have on room-night demand across marketprice segments follows a different pattern than own-price effects. The cross-price substitution effect is significant only for hotels in the low-price segments. In particular, the room-night demand at limited-service midprice hotels and economy hotels is sensitive to market-average ADR. Limited-service properties have a cross-price elasticity of .32, and economy hotels have an elasticity of .44. This can be interpreted as implying

that a 1% change in the overall market-average ADR would result in a demand change of .32% for limited-service properties and a change of .44% for economy hotels. The cross-price substitution effect is insignificantly different from zero for the upper upscale, upscale, and full-service midprice segments.

Finally, the effects of CCI changes on room-night demand imply that demand at only upper upscale and full-service midprice hotels are sensitive to this index. The fact that hotels in these segments are the most numerous in the sample probably explains why this relationship is significant for the sample as a whole. We believe that morework needs to be done to determine the full extent of the effect of consumer expectations on hotel demand.

Conclusion

The current study is the first to examine the relationship between lodging demand and economic factors at the property level using a large cross section of properties and a long time horizon. The underlying data sample is unique in that we have property-level data for 481 properties, during the 1989 to 2000 period. In addition, our econometric estimation procedure accounted for cross-sectional heterogeneity in the estimation of the parameters, heteroscedasticity, and crosssectional and serial correlation of the errors.

The results suggest that various measures of current income, GDP, and CI and PI, expectations of future income, CCI, the own price, ADR, and the price of substitutes, MADR, are statistically important factors influencing lodging demand at the property level for urban hotels in major metropolitan locations. The direction of the impact and the statistical significance of each of these factors on lodging demand are consistent with microeconomic theory.

The income elasticity of lodging demand at the property level is inelastic, less than one, unlike the income elasticity of lodging demand at the aggregate level that has been estimated to be greater than one. In addition, we found that the impact of GDP on lodging demand is similar to the combined impact of disposable PI and CI. The strong relationship between lodging demand and GDP is well established in the literature and is a generally accepted fact among hospitality professionals. However, the fact that the total impact of GDP on lodging demand is similar to the impact of PI and CI was not previously known. Another result of note is that the impact of PI on lodging demand is about twice as large as that of CI. The implications of these results are useful to property owners, investors, and managers because they can use the results to evaluate the impact of a change in GDP or CI and PI on property-level lodging demand.

The own-price elasticity of demand is found to be negative and statistically significant while the cross-price elasticity of demand for substitutes is positive and statistically significant. The overall magnitude of the own-price elasticity is extremely small, –.13%. This implies that price discounts will not enhance revenues because the price elasticity of demand is inelastic. For example, if a 300-room hotel that sells about 240 rooms per day decreases their room rate by 10% from $100 to $90 then room demand will increase by 0.13 × 10, or 1.3%, resulting in an increase in demand of 3.12 rooms per day. Assuming that they were at 80% occupancy before the price drop, rooms revenue would originally be 300 × 0.80 × $100 = $24,000 per day. Now with the price drop to $90, the hotel's rooms revenue is (300 × 0.80 + 3.12) × $90 = $21,880.80 per day. Because it is almost certain that the incremental costs associated with selling the additional rooms will be non-negative, the price drop does not appear to be a wise decision. The positive cross-price elasticity of demand of substitutes of 0.12% implies that if the average rate of all hotels in the market goes up by 1% then the lodging demand at a particular property will go up by 0.12%, holding the values of all other variables constant. The significant relationship between the average price at other properties and property-level demand implies that the demand across properties is correlated. As a result, it is inappropriate to assume independence in the estimation of the parameters of a lodging demand equation.

Consistent with the existing literature, the relative magnitude of the impact of each of these factors on lodging demand varies across lodging market segments. The impact of the income measures decrease from the upper upscale to the economy segment. Whereas the impact of the own price and the cross price of substitutes increase from upper upscale to economy. These results allow decision makers to analyze the impact of changes in GDP, CI, PI, ADR, and the market average ADR in their market on lodging demand by market segment.

The results of our research have certain limitations that affect the model's interpretation in a generalized setting. First, our sample of hotels only considers urban hotels located in the 22 major metropolitan areas selected for the current study. Hotels in outlying areas within the chosen MSAs were excluded as we were concerned only with estimating a model covering hotels in close proximity and hotels in other MSAs were not included as we were looking to see what factors affected the major metropolitan markets. Generalizing these results to all hotels in every market should be done with caution. Second, our sample consisted of only those urban hotels, within our selected markets, with complete data across the 48 quarters between 1989 and 2000. This left us with 481 hotels across all markets. Although more than sufficient for our model to provide robust statistical results, an increasing

number of hotels will have longer periods of complete data as the history tapes of Smith Travel Research continue to be updated over time. In the future, we expect researchers will be able to have larger samples of hotels across longer periods of time.

Finally, we chose to use the average ADR of all hotels in each market as a proxy for the price of substitutes in each market. A valid concern here is whether someone who patronizes an upper upscale hotel will be price sensitive to changes in ADRs in economy and midscale hotels. Although our proxy picked up a clear substitution effect, the precise substitution effect across and between each segment has yet to be determined. Our hope is that the current study of property-level demand analysis leads to future work that addresses these limitations and expands on our work. For example, competitive set analysis is a research area that will benefit models of lodging demand. We considered that there might be a good argument for using the competitive set's average ADR instead of the market-average ADR of the market as a proxy for the price of substitutes. However, we did not have access to what competitive set each hotel was in and, therefore, could not use this measure as the price of substitutes in each market. In addition, it is not clear how to define the competitive set. One approach, used by lodging managers, is to define the competitive set according to market segment. The use of this definition in this model would imply that consumers are only sensitive to the prices of hotels within the same market segment and that they are unwilling to trade up or trade down across market segments as the level of price differentials varied.

Another approach to defining the competitive set, analyzed in the competitive strategy literature, is based on the degree of similarity across various dimensions between the firms. Baum and Mezias (1992) studied localized competition in the Manhattan hotel industry. Size, geographic location, and price were the factors used in determining the degree of similarity. They found that hotels more similar to each other in terms of size, geographic location, and price are more highly competitive than hotels that are less similar on these characteristics. In addition, they found that hotels less similar in terms of size, geographic location, and price are competitive but less than those that are more similar. Research that addresses consumers' willingness to substitute products across all service levels for hotels and across markets is a valuable contribution to this literature.

Another interesting area for future research is the inclusion of local demand drivers in a demand model. In the model, we included national levels of GDP, CI, and disposable PI as the appropriate measures for income driving hotel demand, local demand drivers may also be important. We investigated using market specific data and discovered that data are not available on a quarterly basis

across all markets. Furthermore, these data were often calculated using different base data in different markets. Given the problems associated with using this data in a model estimating demand with pooled data, the question of using market-level data and its effect on property-level demand seemed best left for extensions of this work in future research.

Notes

1. See Hicks (1946, 1956), Keynes (1936), Marshall (1949), Samuelson (1947), Slutsky (1915/1952), and Stigler and Boulding (1952) for the relationship between demand and current income, own price, and the price of substitutes. See Baumol and Blinder (1994), Franke and Bernanke (2001), Friedman (1957), Hamburger (1955), and Samuelson and Nordhaus (1995) for a discussion on the relationship between consumer expenditure and wealth. See Song andWong (2003) for a discussion of the economic factors that influence tourism demand.

2. Instead of including wealth alone, we have included current income and expectations of future income separately as proxies for wealth.

3. GDP is a valid measure of national income because of the national income or product identity. In fact the correlation coefficient between the two is 0.9999 using quarterly measures of the two variables during the period 1946-I through 2003-II.

4. See monthly issues of the Consumer Confidence Survey, The Conference Board, Consumer Research Center for 1989 to 2000.

5. The sample does not include data for each property for each month during the entire period. Some properties did not supply data for each month during the entire period.

6. It is an empirical question whether the parameters of the model are constant across various types of markets. However, it seems reasonable to assume that the price and income elasticities of demand will not be the same in major metropolitan locations as they are in rural locations, for example.

7. The continuous variables were transformed to natural logs (lns) so that their coefficients could be interpreted as elasticities.

8. When two variables are correlated, the variables' statistical power comes from the portion of their variance that does not covary. The portion of their variance that is perfectly correlated is essentially lost, and the resulting coefficient estimates are based on each measure's specific variance.

9. For a detailed description of this methodology see Greene (2000, pp. 444-485). The parameters of the model were also estimated assuming stochastic variation in the parameters. The results are insignificantly different and are available from the authors on request.

10. The random effects approach specifies that the αi is a property-level disturbance, similar to ε_{it} except that for each property, there is but a single draw that enters the regression identically each period. We used the Hausman test for random effects, and the results indicated that a fixed-effects model was more appropriate.

11. Multicollinearity is a potential problem in most empirical work. The important issue is whether the implications of the results change as a result of multicollinearity. The variables in our model that may cause a multicollinearity problem are CI and PI. The correlation between these two variables is .8.We checked whether the exclusion of each of these variables from the model affects the implications of our results. We found that the estimated parameters of the other variables of the equation do not change significantly when either CI or PI are excluded from the equation. For example, when CI and PI are included in the model, the coefficient on CCI is .03, ADR is –.13, and MADR is .12; when PI is excluded, the coefficient on CCI is .04, ADR is –.11, and MADR is .11; and when CI is excluded from the equation, the coefficient on CCI is .05, ADR is –.14, and MADR is .10. Because the implications of the results do not change, we felt that multicollinearity was not a significant problem in our model.

12. See Wheaton and Rossoff (1998).

13. We estimated the parameters of this model at the aggregate national level, and the results are consistent with the results found elsewhere, in that the income elasticity was found to be greater than one.

14. The five price segments are upper upscale, upscale, midprice with food and beverage (full service), midprice without food and beverage (limited service), and economy.

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