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Lodging Demand for Urban Hotels in Major Metropolitan Markets

*by Linda Canina, Ph.D.,
and Steven Carvell, Ph.D.*



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Lodging Demand for Urban Hotels in Major Metropolitan Markets

by Linda Canina, Ph.D., and Steven Carvell, Ph.D.

Hotel demand in large urban markets does respond to changes in income, but that demand is relatively inelastic, according to an analysis of 22 top metropolitan areas in the United States. The analysis, made possible through Smith Travel Research, examined room-night demand for 480 individual hotels from 1989 through 2000 and compared that demand to a set of economic measures, including gross domestic product (GDP) and the consumer-confidence index (CCI). Rather than examine aggregate demand against GDP, for instance, the study took the unusual approach of examining the effects of income on each hotel's demand and then aggregated the individual results. The analysis found that every 1-percent increase in GDP was associated with a .44-percent increase in demand at the urban hotels in the 22 large markets—showing that hotel rooms demand is relatively income inelastic.

The study further examined income effects using a novel approach—by separating GDP into personal income and business income. This additional analysis confirmed

the income inelasticity of hotel demand but also found that personal income changes have twice as great an effect on hotel demand than do changes in business income. Furthermore, the combined elasticity coefficients for personal income and business income approximate the coefficient for GDP.

The analysis of the effect of consumer confidence provided the first known connection between consumers' future expectations for income. While the effect is relatively small, it is significant—with a .03-percent change in hotel demand for every 1-point change in the CCI.

The study also examined price-related elasticity, examining changes in demand both when a hotel changes its own price (ADR) and the substitution effect that occurs competitors' prices change (market ADR, or MADR).

Separating the study sample according to STR's market segments also yielded further insights about the income elasticity of demand for different hotel price points.

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by Linda Canina, Ph.D., and Steven Carvell, Ph.D.

LODGING-INDUSTRY PROFESSIONALS AND ANALYSTS HAVE LONG WONDERED ABOUT the specific effects of economic factors—particularly income and prices—on hotel-room demand. Hotel investors and owners, for instance, need to know how sensitive rooms demand is to economic factors for hotels in a given 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 rooms demand and economic factors for hotels in various price segments and locations 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.

In this report we explain our analysis of how income and price changes affect hotel demand. We examined property-level data from Smith Travel Research (STR), to assess how changes in various measures of income and prices affect room-night demand for 481 urban hotel properties located in 22 of the largest major metropolitan markets across the United States. The economic measures are gross domestic

product (GDP), personal income (PI), business income (BI), the consumer-confidence index (CCI), the hotel’s average daily rate (ADR), and the local market’s average ADR (MADR). In addition, by segmenting the hotels in the data set, we determined the effect on demand of changes in economic factors for hotels in various market-price segments.

Five attributes of this study represent advances in analyzing the economic relationships in hotel-room demand. First, our sample consists of a virtual census of branded hotels for the 22 markets that we studied. Therefore, our study is applicable to property-level decision making across every major metropolitan market in the U.S. and our results are not specific to a particular year or to a particular region of the country.



In Appreciation to Smith Travel Research

This *CHR Report* is made possible through an alliance between The Center for Hospitality Research and Smith Travel Research. Through this alliance with STR, the data are available for the use of The Center for Hospitality Research under non-disclosure and confidentiality agreements that carefully guide the scope and nature of data reporting. The authors acknowledge the support of both Smith Travel Research and the CHR.

Second, the lack of data availability has forced previous studies to use lodging data aggregated to the national level or aggregated to the county level for a specific state. Aggregate-demand models of that kind estimate the income and price elasticity of demand for the overall lodging industry rather than the elasticity for individual hotels. Instead, we examined property-level sensitivity to economic factors, which is quite different from that of the aggregate demand for room-nights. Since an individual hotel's demand is affected by a number of idiosyncratic factors, property-level demand is less sensitive to economic factors than is total demand. This is an important distinction, because the individual-property analysis can lead to an understanding of how property-level demand relates to economic measures. Instead of attempting to gauge local demand from overall industry statistics, property owners and operators will have a more accurate way to assess property's operating risk.

Third, we disaggregated national income, commonly measured as gross domestic product, into business income and personal income, so that managers can better understand the effects of changes in each of type of income on rooms demand (based on their target markets).

Fourth, the specification of our model is based on microeconomic consumption theory. Therefore, our model includes measures of each of the theoretical factors affecting demand—namely, current income,

expectations of future income, own price, and price of substitutes. This results in estimates of the income elasticity of demand relative to GDP, business income, and personal income; the own-price elasticity of demand; and the cross-price elasticity of demand.

Finally, it is well known that rooms demand is highly correlated across time and that rooms demand is also highly correlated among competitors. The study employs statistical analysis that corrects the variance-covariance matrix of the errors for

Rooms demand is correlated across time and correlated among competitors.

both serial and cross-sectional correlation, and homoscedasticity is not assumed.

This report 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 that we used in this study, and we review the methodology that we employed to study the determinants of lodging demand. Finally, we present the results of the model, which is estimated, as we said, for several of the largest metropolitan markets in the U.S. The model and data used focus

on demand estimation at the property level, and the model treats the estimates of the demand equations across properties and markets as a system. Consequently, we contend that the estimates presented here are more accurate and robust than those of

Lodging demand seems to respond more to income factors than it does to price-related factors.

previous studies. We believe that our findings provide insights into the differences in the way room-night demand at different types of hotel respond to changes in the economic factors.

Previous Examinations

In spite of the apparent interest in this topic, we have found relatively few published articles on the effect of economic factors on the demand for hotel room-nights. Choi, Olsen, Kwansa, and Tse modeled the hotel-industry cycle as it related to the overall business cycle, but focused only on the timing of the business cycle and not the underlying factors that cause changes in demand.¹ A model created by Coopers and

¹ Jeong-Gil Choi, Michael D. Olsen, Francis A. Kwansa, and Eliza Ching-Yick Tse, "Forecasting Industry Turning Points: The U.S. Hotel Industry Cycle Model," *International Journal of Hospitality Management*, Vol. 18 (1999), pp. 159-170.

Lybrand implied that the aggregate U.S. hotel demand over the past two decades is best modeled by a four-quarter-distributed lag of GDP combined with current room rates.² Wheaton and Rossoff correctly pointed out that using current lodging rates to explain contemporaneous room demand may create a simultaneity problem.³ 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 employed lagged GDP and room rates, as well as an adjustment term to capture the effect of lodging demand's deviating from the long-run average of room demand. However, neither the Coopers and Lybrand model nor the Wheaton and Rossoff model evaluated the influence of explanatory factors other than GDP and room rates on lodging demand. In addition, due to data restrictions, these two models focused on aggregate rooms 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 lodging demand. Deaton and Muelbauer described a complete model designed to consider demand for products across

² Coopers and Lybrand, conference presentation, 1995.

³ William C. Wheaton and Lawrence Rossoff, "The Cyclic Behavior of the U.S. Lodging Industry," *Real Estate Economics*, Vol. 26, No. 1 (1998), pp. 67-82.

many markets and competitive price points.⁴ Other researchers have explicitly considered the effects of increasing the complementary cost of a lodging stay. Fuji, Khaled, and Mak and Heimstra and Ismail focused on the effect of increasing room taxes on lodging demand.⁵ Palakurthi and Parks evaluated the effect of selected socio-demographic factors such as gender, occupation, age, and income distribution on lodging demand.⁶ While we will not explicitly deal with consumer demographics here, the results of that study imply that hotels catering to different clienteles would experience different price and income elasticity. We do examine this point regarding clientele effects by disaggregating GDP into its business and personal components and by examining rooms sold by market segment.

Research focusing on forecasting international tourism demand also provides evidence regarding the importance of factors that influence

lodging demand other than GDP and a hotel's room rates. Kwack; Summary; and Witt and Martin each showed the influence of transportation costs on the amount spent by travelers abroad.⁷ Kim and Uysal split their sample into classes of hotels based on price points and showed that the effect of prices and other factors are significantly different from each other.⁸ Our study shows that lodging markets in the U.S act similarly in that factors influencing demand for hotel room-nights have different effects for different price segments.

The two papers most relevant to our study are those by Hiemstra and Ismail and by Damonte, Domke-Damonte, and Morse. Hiemstra and Ismail estimated hotel demand using a cross-section sample of 310 properties.⁹ Factors included in that analysis as independent variables were ADR, the number of rooms available, the number of employees, revenue from food and beverage, and the percent-

⁴ Angus Deaton and John Muellbauer, "An Almost Ideal Demand System," *American Economic Review*, Vol. 70, Issue 3 (June 1980), pp. 312-326.

⁵ Edwin Fujil, Mohammed Khaled, and James Mak, "The Exportability of Hotel Occupancy and Other Tourist Taxes," *National Tax Journal*, Vol. XXXVIII, No. 2 (1985), pp. 169-177; and Stephen J. Hiemstra and Joseph A. Ismail, "Impacts of Room Taxes on the Lodging Industry," *Hospitality Research Journal*, 1991, pp. 231-241.

⁶ Radesh Rao Palakurthi and Sara J. Parks, "The Effect of Selected Socio-Demographic Factors on Lodging Demand in the U.S.A.," *International Journal of Contemporary Hospitality Management*, Vol. 12, No. 2 (2000), pp. 135-142.

⁷ Sung Y. Kwack, "Effects of Income and Prices on Travel Spending Abroad, 1960 III-1967 IV," *International Economic Review*, Vol. 13, No. 2 (June 1972), pp. 245-256; Rebecca Summary, "Estimation of Tourism Demand by Multivariable Regression Analysis: Evidence from Kenya," *Tourism Management*, December 1987, pp. 317-322; Stephen F. Witt and Christine A. Martin, "Econometric Models for Forecasting International Tourism Demand," *Journal of Travel Research*, Vol. 25, No. 3 (Winter 1987), pp. 23-30.

⁸ Youngtae Kim and Muzaffer Uysal, "Time-Dependent Analysis for International Hotel Demand in Seoul," *Tourism Economics*, Vol. 4, No. 3 (1998), pp. 253-263.

⁹ Hiemstra and Ismail, *op. cit.*

age of guests on business, as tourists, or attending conferences. They found that the price elasticity of demand varied, depending on a hotel-segment's room rates. The price elasticity of demand was -0.35 for low-price properties and -0.57 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.* consisted of 36 monthly observations on total lodging demand for Charleston County and Columbia County in South Carolina, from December 1992 through November 1995.¹⁰ Two independent variables were included in their model, a quarterly dummy variable and the average ADR for the two counties. 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.

Our analysis expands on those two studies. Our sample consists of 480 urban properties in 22 metropolitan markets studied over 48 quarters. Both the specification of the model and estimation techniques used in our analysis are different from the other

¹⁰L. Taylor Damonte, Darla J. Domke-Damonte, and Stephen P. Morse, "The Case for Using Destination-Level Price Elasticity of Demand for Lodging Services," *Asia Pacific Journal of Tourism Research*, Vol. 3, No. 1 (1998/1999), pp. 19-26.

studies. Unlike the earlier researchers, we considered three current-income measures, as well as expectations of income, ADR, and the market ADR. In contrast, income was excluded from both of the earlier 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. When deciding to estimate the model as a system, as we do in this study, we focused the sample as much as we could 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

Microeconomic consumption theory predicts that the demand for goods and services is a function of current income, expectations of future income, the price of the good or service, and the price of substitutes. Applying this to the demand for hotel rooms results in the following theoretical relationship:

(Equation 1)

Rooms Sold_{*i,t*} = f ((Income)_{*i,t*}, (Expectations of future income | *I_t*), (Room Rate_{*i,t*}), (Room Rate of Substitutes_{*i,t*}))

This relationship states that rooms sold at property *i* in quarter *t* is

some function of income, expectations of future income given the current information set, I_t , the room rate at property i , and the price of hotel rooms at substitutable properties for property i . In the following discussion, we suggest how those independent variables may relate to the dependent variable, rooms sold.

Microeconomic theory predicts a positive relationship between income and demand. Ideally, the income levels of each consumer group should be included as measures of income. The existing empirical work on lodging demand has mainly focused on GDP as the income measure, but some studies, notably those of Witt and Martin and of Wicks, Uysal, and Kim have used measures of personal income.¹¹ We have included three measures of the income variables in our model—namely, gross domestic product, personal income, and business income. We’ve used all three because 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 her or his property, then it may turn out that GDP is a better overall predictor of lodging demand than is PI and BI. However, if the manager is trying to examine the sensitivity of that property’s lodging demand to variations in income for specific target markets, then PI and BI

¹¹ Witt and Martin, *op. cit.*; and B. Wicks, M. Uysal, and S. Kim, “The Effect of Lodging Prices on Visitors’ Demand: Everglades National Park,” *Hospitality Research Journal*, Vol. 17, No. 2 (1994), pp. 51–61.

may be better choices than GDP, because the aggregate figure (GDP) provides little information regarding the hotel’s relative sensitivity to changes in business demand or leisure demand. We expect that personal

Microeconomic theory predicts a positive relationship between income and demand.

income will capture the hotel’s sensitivity to leisure-demand generators and that business income will capture the sensitivity to business-demand generators.

The permanent-income hypothesis suggests that consumption is positively related to both current income and expectations of future income.¹² We use the consumer-confidence index (CCI) as a proxy for people’s expectations of future income (that is, the effect that expectations of future economic conditions have on immediate 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 demand and price, and a positive relationship between demand and the price of substitutes. We used each hotel’s

¹² Milton J. Friedman, *A Theory of the Consumption Function* (Princeton, New Jersey: Princeton University Press, 1956).

EXHIBIT 1
Metropolitan areas examined

Atlanta	New Orleans
Boston	New York, NY
Chicago	Norfolk–Virginia Beach
Dallas	Philadelphia
Denver	Phoenix
Detroit	San Diego
Houston	San Francisco–San Mateo
Los Angeles–Long Beach	Seattle
Miami–Hialeah	St. Louis
Minneapolis–St. Paul	Tampa–St. Petersburg
Nashville	Washington, DC

ADR in the previous quarter as a proxy for the price variable and MADR as a proxy for the price of substitutes. The lagged value of ADR and the lagged value of 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 due to revenue-management programs' responding to demand fluctuations.

Substituting the empirical measures of each of the theoretical variables shown above in equation 1 results in the following regression equation:

(Equation 2)

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

Two Data Sources

The data used in this study come from the following two sources: **(1)** Smith Travel Research, which has a database comprising observations for over 98 percent of the branded lodging properties in the United States, and **(2)** the U.S. Bureau of Economic Analysis. By arrangement with STR, we obtained monthly property-level data for 480 urban hotels in 22 major metropolitan markets in the United States (see Exhibit 1). We started with the top-25 markets, as designated by STR, but excluded Anaheim, Orlando, and Oahu to maintain the homogeneity of our sample. Though 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.

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.¹³ Finally, since 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 non-zero, and the econometric technique employed in this analysis results in the estimation of efficient and consistent parameters.

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, quarterly rooms revenue, and quarterly rooms available for each property, i , for each quarter, t , from 1989 through 2000. We computed each property's quarterly ADR by dividing the quarterly rooms revenue by the quarterly rooms

available. As we indicated above, the estimation procedure employed a one-quarter-lagged value of ADR procedure 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 market ADR was calculated by determining the average ADR of all urban hotels in each market by quarter over 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 demand for urban hotels in the U.S. lodging industry over the sample period. Data over the 1989–2000 sample period for business income, personal income, the GDP deflator, the CPI, and the consumer-confidence index were obtained from the U.S. Department of Commerce's Bureau of the Economic Analysis.

Price and Income Elasticity

The demand equation presented in Equation 2 is estimated using a log-log functional form. This allows us to interpret the regression coefficients (β) as price and income elasticities. Thus, a 1-percent change in the price and income variables would be associated with a β -times-1-percent change in the number of rooms sold. For example, a 1-percent change in business income would result in a β -percent change in

¹³ Hiemstra and Ismail, *op. cit.*; and Damonte *et al.*, *op. cit.* It is an empirical question whether the parameters of the model are constant across various markets. However, it seems reasonable to assume that the price and income elasticities of demand will not be the same in major metropolitan locations and rural locations, for example.

EXHIBIT 2
Demand changes for urban hotels in 22 major metropolitan markets
(using the fixed-effects model)

Dependent variable:
 Number of rooms sold

	<i>Model 1</i> Equation 2 with GDP	<i>Model 2</i> Equation 2 with PI and BI
<i>Independent variables:</i>		
Constant	7.39	7.29
CCI	0.04	0.03
ADR	-0.14	-0.13
MADR	0.08	0.12
<i>Income measures</i>		
GDP	0.44	
BI	0.12	
PI	0.29	
R-Square	0.9300	0.9297

Note: Each coefficient is significantly different from zero at the 95-percent confidence level. The number of cross sections is 481 and the time series length is 48 quarters.

the total number of rooms demanded. The model estimates the income elasticity of demand as related to three different measures of the income variable (i.e., GDP, BI, and PI). In addition, the model estimates the income elasticity of demand with respect to expectations of future income, as measured by the CCI. Finally, it measures the own-price elasticity of demand with respect to ADR and the cross-price elasticity of demand of substitutes as related to the market's ADR. We then subdivided the sample according to market price segments and estimated similar statistics for each segment.

The parameters of Equation 2 were first estimated using GDP as the income measure (which we call Model 1). Then, to determine whether personal income and business income have separate explanatory power in a model of urban hotels across the largest metropolitan markets, we ran Equation 2 again with PI and BI included in place of GDP (thus creating Model 2). Even though BI and PI are correlated, the model will be able to discriminate between them if they have separate effects on lodging demand.¹⁴ Of particular importance is determining whether these income measures are both 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, consumer confidence, price elasticity, and cross-price elasticity vary across different market-price segments. To test this hypothesis we segmented the data into the five market-price segments found in the STR database—namely, upper-upscale, upscale, mid-price with F&B (or, full service), mid-price without F&B (limited service), and economy. Given that consumption of low-price goods and services represents a smaller portion of a typical consumer's income than does

¹⁴ When two variables are correlated, the variables' statistical power comes from the portion of their variance that does not co-vary. 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.

purchase of high-price items, we expected that lodging properties in the mid-scale and economy markets would 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-price segments (that is, from upper-upscale to economy).

Since the sample consists of property-level data by quarter, modeling in this setting calls for some complex stochastic specifications.¹⁵ If we assume that the errors, $e_{i,t}$, in the model are not correlated cross-sectionally, across hotel properties i , or 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, from that, estimate the coefficients by ordinary least squares. That is not a reasonable assumption, however, and, as a consequence, we estimated Equation 2 using feasible generalized least squares (FGLS) to allow for problems relating to autocorrelation and the like.¹⁶

¹⁵ Given that autocorrelation often appears in times-series data, it is unreasonable to assume that the errors are homoscedastic and uncorrelated across the cross-sectional units (the properties).

¹⁶ For a detailed description of this methodology see: William H. Greene, *Econometric Analysis*, second edition (New York: Macmillan, 1993), pp 444–485. The parameters of the model were also estimated assuming stochastic variation in the parameters, with insignificantly different results.

We expected that the coefficients resulting from the estimation of Equation 2 would follow established microeconomic theory. Along that line, we expected that the coefficient of the income effect would be positive and significant, meaning that rising real income would have the effect of

Of particular importance is determining whether personal income and business income both have significant effects on hotel demand.

raising room-night demand. The coefficient for CCI is expected to be positive and significant, whereby rising consumer confidence would have the effect of increasing consumers' willingness to travel and thereby 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 income. The coefficient for ADR_{t-1} is expected to be negative and significant, meaning that increasing property-level ADRs are expected to have the effect of lowering demand. Finally, the coefficient of the cross-price substitution effect, from the average price of rooms in the market, is expected to be positive and significant, whereby rising ADRs for other properties (increasing MADRs) are expected to increase the relative demand for a given property's rooms, since higher room prices at other

hotels would reduce 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 Exhibit 2 (page 14). The first thing to note is the stability of the coefficients across the two models. Regardless of the income measure

Lodging demand in major urban markets is more than twice as sensitive to changes in personal income as it is to changes in business income.

used, the estimated parameters of the other variables are insignificantly different across the two models. Also the adjusted R-squares are insignificantly different from each other.

Income Measures: GDP, BI, and PI

In each case, the coefficient on the income variable is positive and significant, as hypothesized.¹⁷ Moreover, the income elasticity is less than one in each case—indicating relative income inelasticity for hotel demand. For example, the coefficient is 0.44 for GDP. That is, the coefficient smaller than one implies that the number of room-nights demanded for

¹⁷ All findings are significant at the 95-percent confidence level.

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-percent increase in GDP would push up the number of rooms demanded at the average urban property in a major metropolitan market by 0.44 percent, and a 1-percent reduction in GDP would reduce demand by a like 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.¹⁸ The main reason for this difference is due to the level of aggregation used in computing the values of the variables used in estimation.¹⁹

BI and PI. The coefficients for business income and personal income are also both 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 associated with business income (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 business income.

¹⁸ See: Wheaton and Rossoff, *op. cit.*

¹⁹ 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.

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

We hypothesize that the reason for the considerable weight of personal income in our model is that it has both a primary effect and a secondary 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) revenues 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 BI and PI) with

Model 1 (GDP alone), we see no significant difference in the coefficients. The sum of the BI and PI coefficients (0.41) is insignificantly different from the coefficient on GDP (0.44). However, working with the disaggregated coefficients (BI and PI) permits a more complete analysis. For the sake of clarity, only the coefficients of Model 2 will be discussed in the following sections.

Price Effect

The coefficient for the lagged ADR, -0.13, is significant at the 95-percent level of confidence. The implication of this negative coefficient is that a 1-percent increase in the average sample property's ADR would have the effect of decreasing room-night demand by 0.13 percent. (A 1-percent drop in ADR would have a positive effect on demand of similar magnitude.) We conclude, therefore, that rooms 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.

The Market-price Substitution Effect

The coefficient for average market ADR, 0.12, in Model 2 is also significant. The implication of this result is that a 1-percent increase in the overall

market's ADR will have the tendency to increase an average individual property's room-night demand by 0.12 percent (and a decline in MADR will reduce the individual property's demand by a like percentage). Again, we find that a single property's demand is relatively inelastic with regard to changes in competitors' prices (as represented by the total market's ADR). Despite the inelasticity of this price-substitution effect, it's interesting to discover that it exists. We know of no other published research that has identified a price-substitution effect like this 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 this analysis, because demand within markets represents a system that must be estimated simultaneously.

Consumer Confidence: Small but Significant

Small though it is, the coefficient for the consumer-confidence index of 0.03 for Model 2 is statistically significant. The implication of this result is that a 1-percent increase in the level of the CCI will increase a typical urban hotel's rooms demand by .03 percent. Once again, no other published study has found a relationship between consumer confidence and room

demand in the hotel industry. The 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 along with economic conditions when formulating their expectations for hotel demand.

Assessing Different 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 ran the model for each of STR's five price segments. In particular, we were interested in determining whether there are variations across price segments in the income elasticity associated with personal income and business income, and from price and cross-price elasticity. It's not hard to predict that the sensitivity of demand to changes in both PI and BI varies across price segments. The pattern of those variations is not simple to predict, however, due to the likely effects of two simultaneous, counter-vailing forces—those being the income effect and the trading-down, trading-up effect.

On the one hand, the income effect alone suggests that diminishing income would reduce overall demand and rising income would increase overall demand. We see evidence of the "pure" income effect in Exhibit 2, which indicates that as income in-

creases the demand for all hotel rooms also increases. On the other hand, the trading-down, trading-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 midscale or 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 low-price segment hotels. One could argue, then, that demand in the economy segment might be more sensitive to changes in income than are other price segments—and in unexpected directions owing to the trade-down and trade-up effects. At the other end of the scale, we expect that the room-night demand of high-income consumers staying at upper-upscale properties is relatively 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 trade-up effect. It is possible that the trade-up and trade-down effects may offset the pure income effect in some market segments more than others.

The pure income effect and the trading-up, trading-down effect are

both expected to be stronger in low-end segments than in high-end segments. Since these are countervailing effects, we expected that the most pronounced total-income effect is

Small though it is, the effect of the consumer-confidence index on demand is statistically significant.

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-up, trading-down behavior would 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 mid-scale segments.

In general, we expected that the price and cross-price elasticity would follow a similar pattern. That is, properties in low-price segments should 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 mid-scale and economy properties.

Income effects. The outcome of the analysis that we have just been

EXHIBIT 3

Demand by market segment for urban hotels in 22 major metropolitan markets (using the fixed-effects model)

Dependent variable: Number of rooms sold	Upper upscale (1)	Upscale (2)	Midscale with F&B (3)	Midscale without F&B (4)	Economy (5)
<i>Independent variables:</i>					
Constant	7.49*	5.84*	5.25	6.50*	4.70*
CCI	0.04*	0.01	0.05*	0.05	0.04
ADR	-0.15*	-0.11*	0.01	-0.21*	-0.31*
MADR	0.04	0.01	0.05	0.32*	0.44*
<i>Income measures:</i>					
BI	0.09*	0.18*	0.18*	0.16**	0.004
PI	0.34*	0.40*	0.24*	0.17	0.20
<i>Number of cross sections</i>					
	201	63	122	26	69
R-square	0.9148	0.8729	0.8541	0.7916	0.8514

Note: * indicates significantly different from zero at the 95-percent confidence level and ** indicates significantly different from zero at the 90-percent confidence level. The time series length is 48 quarters.

discussing is shown in Exhibit 3, which gives the results for the overall sample of urban hotels broken down into STR’s five segments. The results, on average, are consistent with those reported in Exhibit 2. Overall, the effect of business income and personal income on room-night demand decreases with the segment’s price point. However, different patterns of consumer behavior emerge when we analyze demand across segments.

BI elasticity. To begin with, the elasticity of demand for business income is 0.09 in the upper-upscale segment, but it rises to 0.19 for the upscale segment and stands at 0.18 in the mid-scale full-service segment and 0.16 in the mid-scale limited-service segment. We anticipated that the business-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 business-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 business income declines.

PI elasticity. The results for personal income follow much the

same pattern as those for business income. 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 mid-scale segment. The results for the other segments (0.17 for limited-service mid-scale 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 business income remains statistically significant to rooms demand in the limited-service mid-scale segment, while personal income is not a significant factor. The pure income effect always occurs for the limited-service properties, but our findings imply that the trading-down phenomenon does not occur with business travelers to the extent that it does with individual or leisure travel within this price segment. This is because business travelers "incomes" relate to their business expense accounts not their personal income and, second, that a large proportion of business travel is less discretionary than is leisure travel.

Price elasticity. Turning to the estimated effect of changes in lagged ADR room-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. Price elasticity is -0.15 in the upper-upscale segment and -0.11 in the upscale segment. The price elasticity amplifies to -0.21 in the limited-service mid-scale segment and reaches -0.31 in the economy segment. The only excep-

Business income is statistically significant to rooms demand in the limited-service mid-scale segment, while personal income is not a significant factor.

tion to the foregoing pattern occurs in the full-service mid-scale segment, where the own-price elasticity of demand is not statistically different from zero. While 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 in ADR than 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.

Cross-price substitution. The effect that changes in MADR has on room-night demand across market-price segments follows a different

pattern than own-price effects. The cross-price substitution effect is strongly significant only for hotels in the low-price segments. In particular, the room-night demand at limited-service mid-scale hotels and economy hotels is sensitive to market-average ADR. Limited-service properties have a cross-price elasticity of 0.32, and economy hotels have an elasticity of 0.44. This can be interpreted as implying that a 1-percent change in the overall market-average ADR would result in a demand change of 0.32 percent for limited-service properties and a change of 0.44 percent for economy hotels. The cross-price substitution effect is insignificantly different from zero for the upper-upscale, upscale, and full-service mid-scale segments.

Confidence. Finally, the effects of CCI changes on room-night demand imply that demand at only upper-upscale and full-service mid-scale hotels is 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 more work needs to be done to determine the full extent of the effect of consumer expectations on hotel demand.

Statistically Significant Factors

The underlying data sample is one that has not been previously examined in the way found in this report. We were able to examine property-level data for 480 properties for the period

of 1989 through 2000. In addition, our procedure addressed a number of statistical issues, allowing for cross-sectional heterogeneity in the estimation of the parameters, heteroscedasticity, and both cross-sectional and serial correlation of the errors.

The results suggest that various measures of current income (GDP, BI, and PI) expectations of future income (CCI), the hotel's own price (ADR), and the price of substitutes (MADR) are statistically important factors that influence lodging demand at the property level for urban hotels in major metropolitan locations. The direction of those effects on lodging demand and the statistical significance of each of the factors that we examined are consistent with microeconomic theory.

To review, we found that demand at the property level is relatively inelastic with regard to income, unlike prior calculations of the income elasticity of lodging demand at the aggregate level. In addition, we found that the effect of GDP on lodging demand may be disaggregated into personal income and business income. The strong relationship between lodging demand and GDP is a well established in the literature and is a generally accepted fact among hospitality professionals. However, the fact that GDP's effect on lodging demand can be disaggregated into personal income and business income—while still approximating the total-income effect of GDP—was not previously known. Another result of

note is that the effect of personal income on lodging demand is about twice that of business income. The implications of these results can be useful to property owners, investors, and managers who want to evaluate the effects of changes in GDP on their hotel's demand, or focus on just business income or personal income.

In keeping with microeconomic theory, we found that own-price elasticity of demand is negative, while the cross-price elasticity of demand for substitutes is positive. However, the overall magnitude of own-price elasticity is tiny (-0.13). The finding explains why rising ADRs generally do not noticeably impinge on demand. Also, this finding implies that price discounts will not particularly enhance revenues—supporting those observers who have decried the industry's penchant for discounting room rates.²⁰

Here's a hypothetical example of how the math works according to our model. If a 300-room hotel that sells

²⁰ For example, see: James C. Makens, "Business at Any Price," *Cornell Hotel and Restaurant Administration Quarterly*, Vol. 28, No. 2 (August 1987), pp. 13–15. For a nonrandom approach to price management, see, for instance: Richard D. Hanks, Robert G. Cross, and R. Paul Noland, "Discounting in the Hotel Industry: A New Approach," *Cornell Hotel and Restaurant Administration Quarterly*, Vol. 33, No. 1 (February 1992), pp. 15–23; and Bill Quain, Michael Sansbury, and Stephen A. LeBruto, "Revenue Enhancement, Part 1: A Straightforward Approach for Making More Money," *Cornell Hotel and Restaurant Administration Quarterly*, Vol. 39, No. 5 (October 1998), pp. 41–48.

about 240 rooms per day decreases its room rate by 10 percent (such that its ADR sinks from \$100 to \$90) then rooms demand will increase by 0.13 times 10, or 1.3 percent—which means an increase in demand of 3.12 rooms per day. Assuming that the hotel's occupancy before the price drop was 80 percent, the property's rooms revenue before the discounting would be $300 * 0.80 * \$100 = \$24,000$ per day.

Our findings imply that price discounts will not particularly enhance revenues.

After the price drop to \$90 (and adding the extra rooms demand), the hotel's rooms revenue would be $(300 * 0.80) * \$90 + 3.12 * \$90 = \$21,880.80$ per day. Since it is almost certain that the hotel will incur incremental costs associated with selling and opening the additional rooms, a price reduction does not appear to be a wise decision under this scenario.

The 0.12 coefficient of cross-price elasticity of demand implies that if the average rate in the market goes up by 1 percent then the lodging demand at a particular property will go up by 0.12 percent, 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 inappro-

priate to assume independence in the estimation of the parameters of a lodging-demand equation.

Analyze by segment. In closing, we suggest that hotel managers run analyses of this kind for their own lodging segment. While overall relationships are of general interest, we found that the effects of the variables we tested vary across lodging market segments. That finding is consistent with the existing literature. In general, the demand-elasticity effects of the income measures decrease from

upper-upscale to the economy segment. On the other hand, the effects of the own-price and the cross-price of substitutes generally increase from upper-upscale to economy. As we explained, though, the effects are distinct for each segment—and insignificant for some. Applications of our model should allow decision makers to analyze the effects on demand for their hotel segment of changes in overall income (GDP), business income (BI), personal income (PI), ADR, and market-wide ADR. ■

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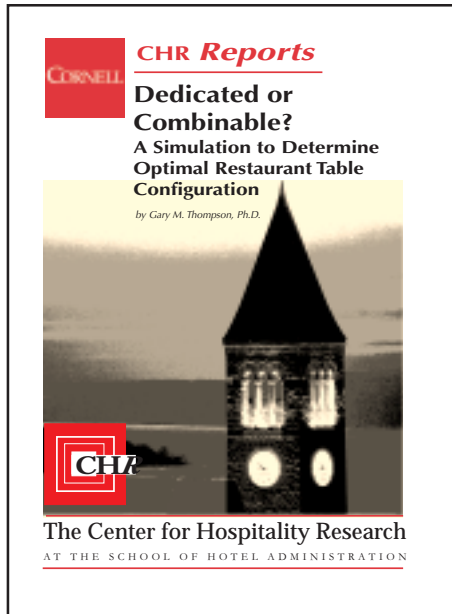
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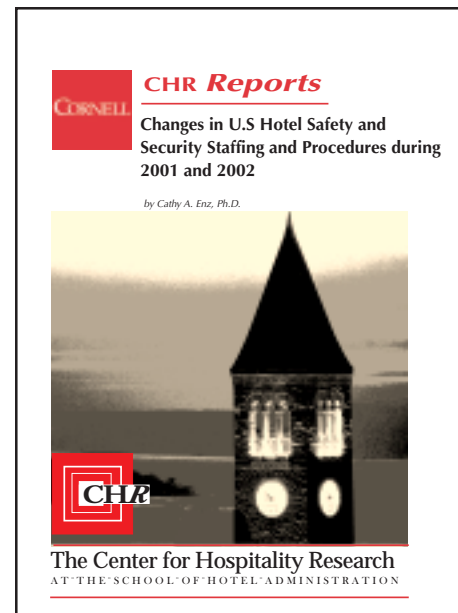
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