How Currency Exchange Rates Affect the Demand for U. S. Hotel Rooms

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Abstract

This study addresses the question of how currency exchange rates affect aggregate hotel demand in the U.S. over time, among chain scales, and gateway cities. The effect is isolated after controlling for hotel room rates, real personal income, and other demand determinants. Exchange rates had a significant, although minor, influence on U.S. hotel demand from 1992 Q1 - 2012 Q1. Disaggregate analyses using data organized by time periods corresponding to Internet availability does not offer new insights about how exchange rates affect U.S. hotel demand. Analyses using chain scale and gateway city data, however, reveal that exchange rates strongly influence hotel demand in luxury, upper-upscale, and upscale segments, with a much weaker relationship among lower-price hotels. The exchange rate effect is strongest for upper-price hotels in gateway cities.

Key Words: Hotel Demand, Currency Exchange Rates, Gateway Cities

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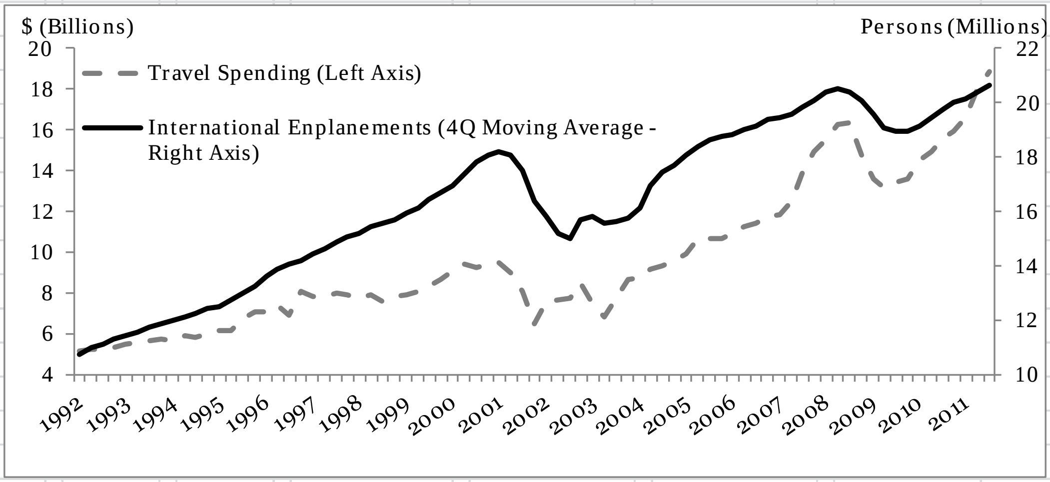
"With a weak dollar, it takes fewer units of foreign currency to buy the right amount of dollars to purchase U.S. goods. As a result, consumers in other countries can buy U.S. products with less money." (Federal Reserve Bank of Chicago, 1997)

1. Introduction

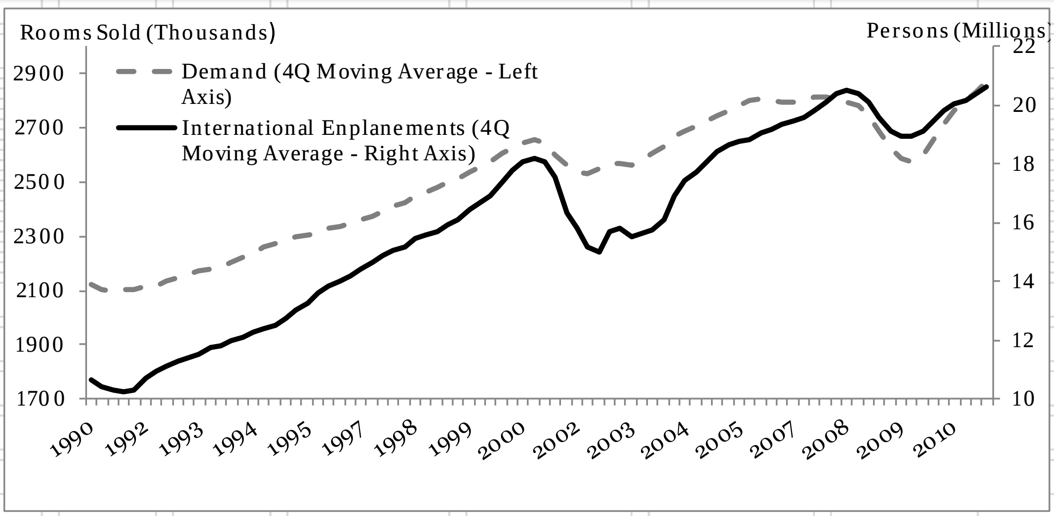
Hotel occupancies in the U.S. increasingly benefit from inbound international travel. As shown in Panel A of Exhibit 1, both expenditures by foreign travelers to the U.S. and enplanements from origins outside the U.S. exceeded historic peaks in 2011. Data presented in Panel B of Exhibit 1 indicate a close and positive relationship between national hotel demand and international travel. Economic theory suggests that a weakened U.S. dollar creates relatively favorable currency exchange rates for foreign visitors and may induce marginal travel to the U.S. Conversely, a weakened U.S. dollar creates disincentives for domestic travelers to make international trips. Yet the data in Exhibit 1 also indicate long-run positive trends among international travel measures both through periods of dollar weakness and strength which suggests that international travel to the U.S. may be invariant to exchange rates.

Exhibit 1: Historic Patterns of Foreign Travel and Hotel Demand in the U.S.

Panel A: Enplanements by Foreign Travelers and International Travel Spending in the U.S., 1992 Q1 - 2011 Q3



Panel B: Enplanements by Foreign Travelers and U.S. Hotel Demand, 1990 Q4 - 2011 Q3

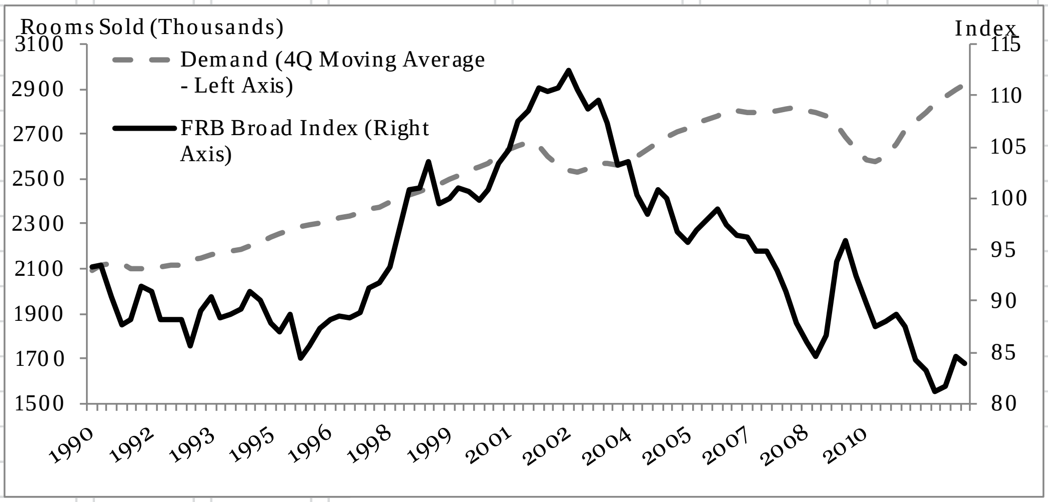


Sources: Federal Reserve Board, International Trade Association, Smith Travel Research, and U.S. Department of Transportation.
Note: Quarterly data in real terms, '97 = 100.

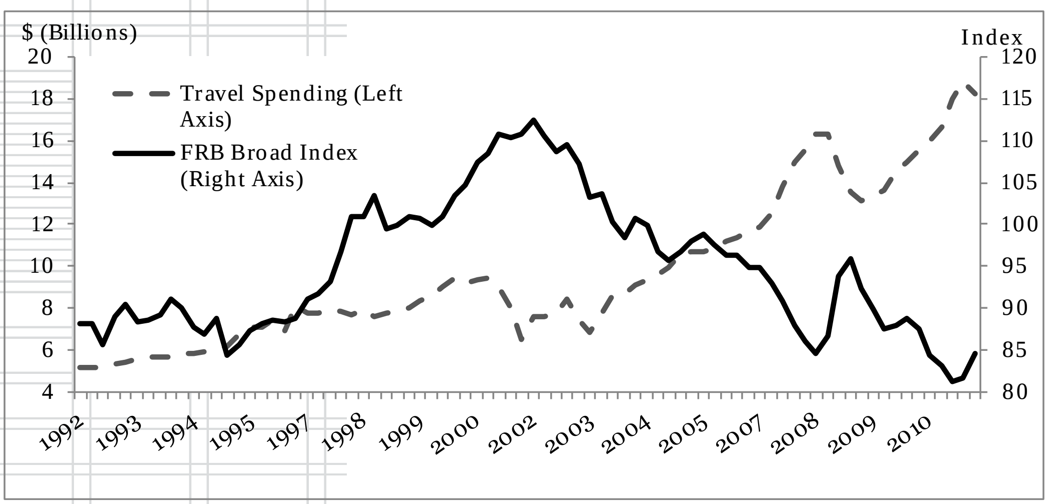
Consistent with the theory that exchange rates influence international travel demand, Panels A and B of Exhibit 2 provide visual evidence of relationships between foreign traveler spending, aggregate hotel demand, and currency exchange rates as measured by the Federal Reserve Board's (FRB) Broad index of international exchange rates relative to the U.S. dollar. The FRB Broad Index is a closely followed composite of global currency relationships. Index numbers less than 100 indicate a relatively weak dollar. In this paper, we report evidence that confirms relationships between exchange rates and hotel demand, albeit largely confined to certain U.S. hotel chain scale segments and in some cities.

Exhibit 2: Historic Patterns of Exchange Rates, Hotel Demand, and International Spending

Panel A: FRB Broad Index and U.S. Hotel Demand, 1990 Q1 – 2012 Q1



Panel B: FRB Broad Index and Internatic



Sources: Federal Reserve Board, I

Note: Quarterly data in real terms,

Our study is the first to estimate the extent to which the number of rooms sold in the U.S. is influenced by currency exchange rates while controlling for other demand determinants. The travel demand literature prior to 1993 reviewed in Crouch (1994) includes 25 studies (*i.e.*, 29 percent of all studies) in which exchange rates appear as a determinant along with other demand drivers. None of the studies cited concentrate on travel to the U.S. Recent published research we review below provides little guidance for understanding whether or not exchange rates affect travel to the U.S. Academic hospitality studies of exchange rate effects are concerned with international firm exposure to exchange rate risk and evaluation of hedging strategies (Singh and Upneja, 2007; Singh, 2009; Chang, 2009; and Lee and Jang, 2010).

The focus here is on the fundamental demand drivers for U.S. hotel room sales that create opportunities for profitability in the short run. Standard hotel demand equations include measures of domestic economic conditions along with average daily room rate (ADR). The original model developed by Wheaton and Rossoff (1998) serves as a building block for econometrically-based demand forecasts produced by industry research firms (PKF Hospitality Research 2012). We introduce the FRB exchange rate index to the standard hotel demand equation and estimate its incremental effects.

We find that currency exchange rates have a statistically significant, although rather modest, influence on hotel demand in the U.S. at the national level of aggregation over the sample period 1992 Q1 through 2012 Q1. Tests for temporal aggregation bias indicate that hotel demand responded to currency exchange rates differently prior to 2000 than after 2000. Regressions run using post-2000 data produce estimates in line with expectations from theory, but are not materially different from those produced with data from the entire sample period. Our analysis shows that exchange rates have an impact on demand at the chain scale level of aggregation, but the coefficients are only correctly signed and significant for luxury, upper-upscale, and upscale hotels. We find no relationship between exchange rates and the number of rooms sold in the national, upper-midscale, midscale, and economy chain scales.

When estimating separate demand equations for U.S. gateway cities, each at both the upper-price and lower-price tiers, we find stronger evidence that exchange rates influence hotel demand at the upper price-tier in these cities than for the nation. The demand for upper-priced hotels is statistically related to exchange rates in seven of eight U.S. gateway cities; Honolulu being the exception. These relationships weaken among lower-price hotels located in the gateway cities.

The remainder of the paper is organized as follows. Section 2 contains a discussion about hotel demand determinants and presents the findings from related literature. Section 3 describes the data and explains variable construction. The methodology and econometric issues also are discussed in this section. Section 4 presents results from the analysis of national, chain scale, and gateway city data. Concluding remarks are made in Section 5.

2. Exchange Rates and Travel Demand

Domestic economic conditions strongly influence the number of hotel rooms occupied in the U.S. (Wheaton and Rossoff, 1998). This fundamental connection between the economy and hotel demand has remained consistent through time and persists at various levels of aggregation from the national level down to city sub-markets. Accordingly, the statistical relationships between room sales and dominant macroeconomic variables, along with average daily rate, serve as the foundation for both research and econometric forecasts of hotel demand. Other explanatory variables intermittently enter hotel demand equations as environmental shocks (*e.g.*, Hurricane Katrina) and unexpected changes in business conditions (*e.g.*, reduction in airline capacity) occur that alter fundamental relationships.

Recent fluctuations in exchange rates among worldwide currencies invite unanswered questions about how currency values affect a variety of business and consumer behaviors including international travel to the U.S. The relationship between currency exchange rates and hotel demand is potentially complicated. The relative purchasing power of either strengthening or weakening currencies against the U.S. dollar may have meaningful influences on the number of hotel rooms sold in some U.S. markets and far less so in others. Cities that typically receive the most inbound international travelers may experience relatively large swings. The effects of changes in currency values also may be felt in some hotel chain scales more than others. Abnormally favorable and unfavorable exchange rates likely incentivize individuals and firms into exaggerated travel behaviors. As exchange rates stabilize and possibly revert to long-run averages, these effects may diminish or disappear.

It was once thought that observable exchange rates acted as a proxy for difficult to observe prices of goods and services in the destination countries of international travelers (Gray, 1966). Rugg's (1973) theory of consumer travel, for example, does not treat exchange rates as independent of the cost of transportation and price relatives in countries of origin and destination. Any explanatory power derived from exchange rate variables in tourism demand equations therefore represented effects resulting from opaque destination pricing (Witt and Martin, 1987).

Information problems facing international travelers during pre-Internet years may be responsible to varying degrees for the inconsistent empirical findings regarding the importance of exchange rates to tourism demand from several early studies reviewed by Iroegbu (2006). Approximately one half of these studies found statistically significant relationships between arrivals in destination nations and exchange rates while the other studies failed to find any connection. Information problems regarding destination country prices largely disappeared during the past dozen or so years; and thus the effects of destination pricing and exchange rate movements now independently operate on travel demand. Tourism research of exchange rate effects on demand performed using data from the post-Internet era is surprisingly thin and the findings remain inconsistent. A recent study of international tourism in Thailand by Chiaboonsri, Chaitip, and Rangaswamy (2009), for example, produced elasticity estimates ranging from –23.63 (France) to 3.93 (Malaysia). In an analysis of exchange rate variation and tourist arrivals to Italy from 19 other nations, Quadri and Zheng (2010) find that exchange rates have no effect on tourism demand. Only Bailey, Flaneigin, Racic, and Rudd (2009) present evidence on the currency exchange rates effect on hotel occupancy using recent data, however their results come from a univariate analyses absent of controls afforded by a fully-specified demand model.

3. Data and Demand Model

3.1 Data

Hotel demand, measured by number of rooms sold per period, and average daily rate data come from Smith Travel Research. The data for all variables introduced as economic controls come from Moody's Analytics. Smith Travel Research collects hotel performance data for over 40,000 hotels in the U.S. each month. This sample covers a large proportion of all U.S. hotels with more than 20 rooms. Moody's Analytics is a prominent aggregator of national and local economic data. The U.S. Department of Transportation (2012) is the source of international airfare data. These quarterly hotel and economic data span the period 1988 Q1 through 2012 Q1. The airfare time series data begin in 1992 Q1. For exchange rates, we use the Federal Reserve Board (FRB) Broad Index. The FRB explains that their broad exchange rate index "aggregates and summarizes information contained in a collection of bilateral foreign exchange rates" and that, "the main objective of the current indexes is to summarize the effects of dollar appreciation and depreciation against foreign currencies on the competitiveness of U.S. products relative to goods produced by important trading partners of the United States" (Loretan, 2005, p.1). The 26 currencies included in the index as displayed in Exhibit 3 are determined by Federal Reserve Board staff from their annual import/export share of U.S trade. The weights of each component of this index appear in Exhibit 3 alongside the name of the country and its currency. The index is reported in real terms to account for relative changes in international inflation rates.

Exhibit 3: FRB Broad Index Components

Country	Unit	Weight (%)	Country	Unit	Weight (%)	Country	Unit	Weight (%)
Argentina	Peso	0.636	India	Rupee	1.935	Saudi Arabia	Riyal	0.968
Australia*	Dollar	1.430	Indonesia	Rupiah	1.149	Singapore	Dollar	1.987
Brazil	Real	2.223	Israel	Shekel	1.106	Sweden*	Krona	0.798
Canada*	Dollar	12.926	Japan*	Yen	7.281	Switzerland*	Franc	1.681
Chile	Peso	0.870	Korea	Won	3.922	Taiwan	Dollar	2.552
China	Yuan	20.347	Malaysia	Ringgit	1.555	Thailand	Baht	1.411
Colombia	Peso	0.624	Mexico	Peso	11.255	United Kingdom*	Pound	3.421
Euro area*	Euro	16.507	Philippines	Peso	0.547	Venezuela	Bolivar	0.412
Hong Kong	Dollar	1.279	Russia	Ruble	1.177			

Source: Federal Reserve Board.

Descriptive statistics for the U.S. data appear in Exhibit 4, Panel A. The currency exchange rate index, the focus variable in this study, shows considerable variation during the period ranging from 81.21 to 112.38. Correlations using the entire time series (*i.e.*, 1988 Q1 - 2012 Q1) for combinations of hotel demand, real average daily rate, economic controls, real airfare, and the FRB Broad Index are provided in Panel B. The note at the bottom of Exhibit 4 gives variable definitions. Lagged values for some variables are shown as they appear in regressions. The correlation coefficients indicate potential colinearity problems among economic controls, between economic controls and lagged real average daily rate, and between lagged real air fare and the FRB index. We manage some of this colinearity by using changes in, rather than levels of, alternative economic controls in our regressions. Certain variables that closely correlate with other variables are eventually dropped.

Exhibit 4: Statistical Information for U.S.

Panel A: Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.
D (Millions)	2.48	3.49	1.76	3.23
RADR (82-84$)	45.79	2.44	41.24	51.22
EMP (Millions)	124.10	10.38	104.97	137.94
EMP Δ (YOY%)	1.1%	1.8%	-5.0%	3.4%
RPI ($ Millions)	9051	1751	6367	11528
RPI Δ (YOY%)	2.6%	2.2%	-4.7%	6.9%
XE ('97=100)	94.32	7.57	81.21	112.38
RAIRF (82-84$)	995.38	153.51	648.64	1457.14

Panel B: Correlation Matrix – Variables in U.S. Regressions, 1988 Q1 - 2012 Q1

Variable	D-1	RADR -1	EMP	EMP Δ	RPI	RPI Δ	XE-1	RAIRF -1
D_{-1}	1							
$RADR_{-1}$	0.45	1						
EMP	0.75	0.69	1					
EMP Δ	-0.19	-0.08	-0.27	1				
RPI	0.76	0.59	0.95	-0.41	1			
RPI Δ	-0.03	0.10	-0.04	0.84	-0.19	1		
XE_{-1}	0.15	0.38	0.36	-0.11	0.17	0.05	1	
$RAIRF_{-1}$	0.18	0.12	0.01	0.05	0.18	0.01	-0.69	1

Panel C: Correlation Matrix – Variables in U.S. Regressions, 2000 Q1 - 2012 Q1

Variable	D-1	RADR -1	EMP	EMP Δ	RPI	RPI Δ	XE-1	RAIRF -1
D_{-1}	1							

$RADR_{-1}$	0.10	1.00						
EMP	0.28	0.76	1.00					
ΔEMP	0.21	0.17	0.37	1.00				
RPI	0.36	0.12	0.49	-0.07	1.00			
ΔRPI	0.16	0.21	0.30	0.92	-0.15	1.00		
XE_{-1}	-0.34	-0.01	-0.28	0.00	-0.90	0.08	1.00	
$RAIRF_{-1}$	0.34	0.18	0.19	-0.01	0.69	-0.08	-0.81	1.00

Sources: Federal Reserve Board, Moody's Analytics, Smith Travel Research, U.S. Department of Transportation.
Note: The following variable identifiers apply: D–Number of rooms sold (demand), RPI–Real personal income, EMP–Total U.S. employment, RADR–Real average daily rate, XE – FRB Broad Index, and RAIRF - Real airline fares paid by visitors to U.S.

As discussed in an upcoming section, reported results come from the latter half of the period in which data are available (*i.e.*, 2000 Q1 through 2012 Q1), rather than from the entire time series. Using only post-2000 data is economically justified given the advent of the Internet and the international transparency in travel pricing it brought, but as demonstrated this division of the data does not seriously compromise statistical precision. In addition as shown in Panel C of Exhibit 4, the correlation coefficients among variables is generally reduced compared with those reported in Panel B of the exhibit.

3.2 Variable Construction

The objective of this empirical work is to estimate the effects of exchange rates on hotel demand while controlling for as many other factors as possible that may explain variation in the number of hotel rooms sold per quarter in the U.S. As with any demand equation, ours includes a price variable with an expected negative coefficient. The average daily rate, expressed in real terms and lagged one quarter to account for booking decisions prior to occupancy, controls for movement in the price of hotel rooms. Hotel demand also is influenced by either general (*i.e.*, national) or local (*i.e.*, city) economic conditions, hence we introduce two economic controls – real personal income and employment. The levels of these variables are highly collinear, thus one variable enters the equations as a level while the other enters as a year-over-year percent change. Coefficients of both economic controls should be positive. We rely on two economic controls because at certain times hotel demand has greater sensitivity to one economic effect far more than the other. During the recovery following the financial crisis of 2008 and the subsequent recession, for example, U.S. hotel markets experienced a sustained recovery mainly driven by strong income growth. At other times employment dominates.

International traveler demand for hotel rooms in the U.S. should be influenced by costs other than the cost of hotel rooms. The air transportation expenditures represent another large outlay by foreign visitors. We account for transportation price movements with the inclusion of real international airfares in the demand equations. The coefficient for this variable should be negatively signed.

We recognize the interruption in hotel demand coming from domestic and international sources during the period surrounding the terrorist attack in the U.S. on September 11, 2001. Thus the demand model is estimated with a dummy variable designed to capture the interruption. Finally, seasonality is accounted for by including quarterly dummies with the fourth quarter as the omitted period in the series.

3.3 Partial Adjustment Model

We model hotel demand within a single equation, partial adjustment framework. Translation of the theoretical partial adjustment model into estimation form results in the inclusion of a lagged dependent variable on the right hand side and a more complicated coefficient vector than typically found in regression equations (Pindyck and Rubinfeld, 1998). The model presupposes that a market is in disequilibrium and moves over time to the desired (*i.e.*, equilibrium) level. Movement to the desired level is represents by the differences between the demand in period t and the demand in period t-1. The coefficient of the lagged demand incorporates the speed of adjustment parameter, λ, indicating how rapidly the market moves toward equilibrium each period. This coefficient is $1-\lambda$. Consequently, the entire coefficient vector incorporates the speed-of-adjustment parameter as shown in Equation (1). Introducing fundamental demand determinants; the real average daily rate (RADR), changes in real personal income (ΔRPI), and employment level (EMP); also air transportation cost (RAIRF), the 9/11 dummy (D911), seasonal adjustment factors (Q_i), , and the focus variable - the exchange rate (XE) - yields the form of our empirical time-dimensioned (t) specification, as follows:

$D_t = \beta_0\lambda + \beta_1 D_{t-1} + \beta_2\lambda RADR_t + \beta_3\lambda\Delta RPI_t + \beta_4\lambda EMP_t + \beta_5\lambda RAIRF_t + \beta_6\lambda D911_t + \beta_7\lambda XE_t + \Sigma\beta_i\lambda Q_{it} + \lambda u_t$ (1) where $\beta_1 = (1-\lambda)$.

Equation (1) can be estimated by OLS with adjustments for autocorrelation and differentially applied for estimation of U.S. aggregate hotel demand, hotel demand across hotel chain scales, and for upper-price and lower-price hotels in gateway cities. Each β and elasticity is recovered by extracting the common speed-of-adjustment parameter.

3.4 Aggregation Bias

The problem of aggregation bias has been examined in macroeconomics (Theil, 1954), urban economics (Goodman, 1998), hotel revenue management (Weatherford, Kimes, and Scott 2001), and other disciplines. Adding observations by aggregating data increases statistical power and efficiency, but also may reduce forecasting accuracy and understanding of underlying behavioral relationships that comes from analyzing micro-level data. Aggregation bias may be summarized as the problem of macro parameters deviating from the averages of the component micro parameters (Theil, 1954). We investigate the potential for aggregation bias in both the time and cross-sectional dimensions.

Referring to previously displayed Exhibit 2, it can be seen that the relationship between the FRB Broad Index and hotel demand has a different pattern in the sub-period prior to the early

2000s (*i.e.,* sub-period 1) than in the sub-period since the early 2000s (*i.e.,* sub-period 2). Not only does the Smith Travel Research data base cover more of the U.S market in sub-period 2, the ability of international travelers to make informationally efficient decisions has been greatly enhanced since 2000 by the widespread availability of the Internet. If the parameters differ in the two sub-periods when assuming they are the same results in biased estimates. To investigate the potential bias, we perform a Chow test using the dummy and interactive variable method suggested by Kennedy (2003, p. 255). The test statistic indicates a significant difference in the parameter vector (F = 3.77, d.f. = 36). Hence, we proceed by estimating the demand model parameters with recent data from sub-period 2.

Also, we suspect aggregation bias from combining hotels of very different price and quality characteristics. This type of aggregation bias has been shown to exist in housing markets by Zietz, Zietz, and Sirmans (2008). At the national level of aggregation, the U.S. hotel industry includes approximately 65,000 properties of various sizes, ages, quality levels, locations, brand names, and customer bases. The universe of approximately 52,000 hotels and nearly 5,000,000 rooms assembled by Smith Travel Research is widely viewed as 'the U.S. hotel industry'. This assemblage excludes properties with fewer than 20 rooms and includes most hotels with brand affiliations and many independent hotels inside the U.S. boundaries. The Smith Travel Research universe is organized into six chain scale divisions each consisting of branded hotels of similar quality and ADR plus a large independent hotel category. The number (percent) of hotels in each chain scales is as follows (Smith Travel Research, 2012):

Luxury – 307 (.6%)
Upper Upscale – 1,513 (2.9%)
Upscale - 3,760 (7.2%)
Upper Midscale – 8,776 (16.8%)
Midscale – 5,336 (10.2%)
Economy – 10,363 (19.9%)

Independent – 22,098 (42.4%)

These data reveal that the hotel industry is not an evenly distributed collection of operating businesses. Many more U.S. hotels operate in the economy segment than other chain scales. Also, a large number of independent hotels would logically fall into the economy segment if classified according to chain scales along price and quality lines. Of central concern here is the heterogeneous nature of the physical quality, location, and customer bases across the spectrum of chain scale and independent classifications. Such heterogeneity suggests that a demand model estimated using national level data may not provide useful information about micro parameters, particularly currency exchange rate effects. For the disaggregate analysis of U.S. hotel demand determinants along price and quality dimensions, we use data divided by chain scale and exclude the independent category.

Finally as shown in several real estate studies, regression estimation with data aggregated across local markets disguises the micro parameters endemic to those markets (see, for example, Goodman, 1998). We are especially interested in the differential effects of exchange rates on demand in large hotel markets serving many international travelers so we estimate unique demand equations in eight gateway cities. For local market estimations, the Smith Travel Research data allow for the incorporation of independent hotels into price/quality segments by redefining the U.S. industry into the following two categories:

1. ***High-Price Hotels*** - including luxury, upper-upscale, and upscale chain scales plus those independent hotels in the high price range as defined by Smith Travel Research.
2. ***Low-Price Hotels*** – including upper-midscale, midscale, and economy chain scales plus those independent hotels in the low price range as defined by Smith Travel Research.

4. Results

4.1 National Results

Exhibit 5 displays results from estimating national demand equations with different time series and XE alternatively introduced with one-quarter through four-quarter lags. Model 1 uses the available time series and a one-quarter lag on the currency exchange rate variable. The time series has 80 instead of 96 quarters of data because the real airfare data begin in 1992 Q1 rather than 1988 Q1. We obtain parameter estimates by OLS, but when the Breusch-Godfrey χ^2 test statistic exceeds the critical value and thus indicates the presence of autocorrelation as it does with all models shown in Exhibit 5, we re-run the regressions using a procedure suggested by Aschheim and Tavlas (1988). Kennedy (2003) recommends this type of test for autocorrelation with partial adjustment models because of the possibility that errors are correlated at higher orders than one due to the presence of the lagged dependent variable. Aschheim and Tavlas (1988) show that standard correction procedures for autocorrelation work in short-run demand estimation, but lead to inconsistent parameter estimates in long-run demand models.

Most of the explanatory variable coefficients are significant at the .10 level or better and correctly signed except the change in real personal income variable and the one-quarter lag of real airfare variable. We anticipated problems from introducing real airfare into the demand equation given its strong correlation with other right-side variables, especially the currency exchange rate. Importantly, currency exchange rate lagged one quarter performs as expected with a significant negative coefficient. The coefficient on the lagged dependent variable ($1-\lambda$) includes the speed of adjustment parameter such that the market demand for U.S. hotels adjusts to equilibrium at a speed of .82 (*i.e.,* 1-.18) per quarter, that is, to full adjustment in just over one quarter. The elasticity of -.17 indicates a weak demand response to exchange rate movements such that on average a ten percent change in exchange rates results in only a 1.17 percent change in hotel demand. All elasticity numbers are generated after recovering β from the estimated coefficients because, as shown in Equation (1), the estimated coefficients include both β and λ.

Exhibit 5: U.S. Hotel Demand Regression Results

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	-154599.00	391699.80	475403.40	440367.50	113825.80
	(-1.02)	(0.79)	(1.18)	(1.02)	(0.25)
D_{-1}	0.42*	0.52*	0.54*	0.50*	0.58*
	(4.35)	(4.23)	(5.61)	(4.64)	(5.44)
$RADR_{-1}$	-30250.32*	-25047.22*	-23656.18*	-26888.41*	-28903.68*
	(-5.97)	(-3.72)	(-5.08)	(-5.50)	(-5.38)
RPI∆	750368.20*	1069368.00*	1040975.00*	1101923.00*	1057295.00*
	(2.84)	(3.87)	(3.97)	(3.86)	(3.30)
EMP	22986.32*	15093.38*	13864.28*	16437.32*	17172.45*
	(7.10)	(2.47)	(3.22)	(3.58)	(3.41)
Q1	226801.80*	293003.10*	304170.70*	279468.40*	320029.20*
	(4.51)	(4.50)	(5.90)	(4.88)	(5.60)
Q2	606534.00*	669383.30*	678296.00*	658916.80*	699402.50*
	(13.26)	(11.69)	(14.26)	(12.56)	(13.53)
Q3	573435.40*	579465.60*	581145.80*	577888.70*	587198.30*
	(39.14)	(34.96)	(38.00)	(36.47)	(36.74)
$RAIRF_{-1}$	33.13	22.49			
	(0.53)	(0.31)			
XE_{-1}	-3038.50*	-3575.68*	-3856.44*		
	(-2.48)	(-2.63)	(-3.77)		
XE_{-2}				-4099.69*	
				(-3.53)	
XE_{-4}					-3214.73*
					(-2.60)
ηXE	-0.11	-0.13	-0.14	-0.15	-0.12
N	80	49	49	49	49
Adj. R^2	.99	.99	.99	.98	.98
Breusch-Godfrey χ^2	7.48*	3.08*	2.78*	4.69*	6.51*

Sources: Federal Reserve Board, Moody's Analytics, International Trade Association, Smith Travel Research, and U.S. Department of Transportation.
Note: This table presents OLS estimates of coefficients for determinants of U.S. hotel demand using data from 1992 Q1 through 2012 Q1. The dependent variable is D–Number of rooms sold (demand). The following variable identifiers apply: RPI–Real personal income, EMP-Total Employment, RADR–Real ADR, Q1-Q3–Quarterly dummies, XE–FRB Broad Index, RAIRF- Real Inbound Airline Fares, and ηXE–Elasticity of XE. t-statistics in parentheses and * indicates significant at the 10 percent or better levels.

Exhibit 5: U.S. Hotel Demand Regression Results

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-121125.10	100611.40	367598.30	275668.30	84202.53	34062.80
	(-0.47)	(0.19)	(0.82)	(0.50)	(0.17)	(0.07)
D_{-1}	0.18*	0.40***	0.48***	0.35***	0.44***	.046*
	(1.73)	(3.04)	(4.63)	(3.01)	(3.68)	(4.05)
$RADR_{-1}$	-34401.51***	-31417.80***	-27075.04***	-33255.68***	-32986.19***	-33702.45***
	(-5.99)	(-4.37)	(-5.35)	(-5.92)	(-5.91)	(-6.03)
ΔRPI	477958.30	1094447***	995229.90***	991867.5***	1004261.00***	1045276.00***
	(1.63)	(3.91)	(3.60)	(3.14)	(3.14)	(3.22)
EMP	30761.05***	21187.10***	17360.08***	23430.47***	22152.41***	22409.59***
	(9.06)	(3.21)	(3.67)	(4.30)	(4.13)	(4.18)
Q1	101734.00*	230276.70***	266912.50***	199985.90***	244675.80***	253687.10***
	(1.91)	(3.30)	(4.92)	(3.25)	(3.85)	(4.23)
Q2	541361.40***	613552.00***	643713.20***	586433.70***	628612.90***	637423.60***
	(9.48)	(9.91)	(12.74)	(10.20)	(10.74)	(11.56)
Q3	541361.40***	568616.50***	574215.90***	562818.30***	571522.00***	574314.00***
	(35.54)	(33.93)	(37.73)	(35.62)	(34.37)	(36.38)
$RAIRF_{-1}$	-29.79	76.54				
	(-0.44)	(0.99)				
Sept. 11th Dummy	-104185.30***	-49854.35**	-44028.00***	-66246.84**	-57904.12**	-63915.92***
	(-4.30)	(-1.94)	(-3.38)	(-2.56)	(-2.19)	(-2.42)
XE_{-1}	-3849.60***	-2707.27*	-3709.12***			
	(-2.62)	(-1.86)	(-3.38)			
XE_{-2}				-4266.00***		
				(-3.17)		
XE_{-3}					-3365.83**	
					(- 2.55)	
XE_{-4}						-3369.94**
						(-2.64)
ηXE	-0.17	-0.16	-0.32	-0.24	-0.23	-0.23
N	80	49	49	49	49	49
Adj. R^2	.99	.99	.99	.99	.99	.99
Breusch-Godfrey χ^2	8.47***	3.58*	3.25*	5.42**	5.71**	6.78***

Sources: Federal Reserve Board, Moody's Analytics, International Trade Association, Smith Travel Research, and U.S. Department of Transportation.
Note: This table presents OLS estimates of coefficients for determinants of U.S. hotel demand using data from 1992 Q1 through 2012 Q1. The dependent variable is D–Number of rooms sold (demand). The following variable identifiers apply: RPI–Real personal income, EMP- Total employment, RADR–Real average daily rate, Q1-Q3–Quarterly dummies, XE–FRB Broad Index, RAIRF- Real inbound airline fare, and ηXE–Elasticity of XE. t-statistics in parentheses and * indicates significant at the .10 percent level, ** at the .05, and *** at the .01 level. χ2 statistic (d.f. =1), * indicates significant at the .10 percent level, ** at the .05, and *** at the .01 level. Adjustment for autocorrelation when Breusch-Godfrey χ2 exceeds critical value.

Model 2 replicates Model 1 but instead with sub-period 2 data (*i.e.*, 2000 Q1 – 2012 Q1). The Model 2 results are consistent with those obtained with the longer time series; and we place greater trust in the economic significance of relationships from post-2000 vis-á-vis the pre-2000 sub-period because of widespread Internet availability. The exchange rate elasticity alternatively estimated with the two models does not indicate sensitivity to time period.

In Model 3 we drop real airfare due to co-linearity with exchange rate and re-estimate the demand equation using a one-quarter lag on currency exchange rate. The results are nearly identical to Model 2 except, as expected, for the larger exchange rate coefficient and elasticity, which increases from -.17 to -.32. Models 4 and 5 extend the lag on exchange rate to two, three, and four quarters, respectively, to test whether a longer purchase decision period exists. These longer lags on exchange rates do not result in meaningful changes to the coefficient vector while the exchange rate coefficient becomes increasingly smaller and less significant. Hence we rely on a one-quarter lag on exchange rate in all regressions estimated with disaggregated data.

4.2 Chain Scale Results

To determine if disaggregating the national data along average daily rate and quality dimensions provides additional insights about the effect of currency exchange rates on U.S. hotel demand, we estimate separate demand models for the six chain scales defined by Smith Travel Research. In some regressions real personal income lagged one quarter is introduced as an economic control in place of the change in real personal income, and accordingly, employment replaces the change in employment.

Exhibit 6: Results from Hotel Chain Scale Demand Regressions

Variable/Scale	Luxury	Upper Upscale	Upscale	Upper Midscale	Midscale	Economy
Constant	-41687.56	291403.60***	198948.80**	261079.10*	-504819.20***	-352975.50*
	(-1.60)	(3.05)	(2.00)	(2.75)	(-3.12)	(-1.95)
D_{-1}	0.69***	0.32***	0.33***	0.47***	0.04	0.04
	(8.75)	(3.03)	(3.08)	(3.89)	(0.29)	(0.36)
$RADR_{-1}$	-361.92***	-1732.21***	-3938.28***	*-5162.25***	-2310.45	-6660.48**
	(-5.78)	(-4.49)	(-4.98)	(-4.33)	(-1.35)	(-2.46)
ΔRPI	903.00***	965.33	25.67***	17.92**	4199.88***	6440.20***
	(3.96)	(1.43)	(3.26)	(2.67)	(3.73)	(4.27)
EMP	11632.73	156275.10***	113452.20	357985.60***	131323.70**	85179.54
	(0.97)	(3.00)	(0.83)	(3.06)	(2.46)	(1.23)
Q1	9945.85***	27923.99***	20520.39***	357985.60**	-652.28	-17862.48**
	(10.35)	(6.67)	(4.64)	(2.83)	(-0.08)	(-2.73)
Q2	11040.00***	56166.96***	52122.71***	9918.56***	42955.91***	39218.55***
	(11.30)	(16.61)	(13.38)	(8.83)	(5.23)	(4.35)
Q3	4937.57***	39899.69***	40638.59***	89263.77***	60999.10***	72682.62***
	(6.52)	(16.09)	(21.07)	(25.11)	(21.21)	(7.01)
Sept. 11 Dummy	514.55	-15599.31***	-7183.19	-3170.22	-10553.95***	-9309.83**
	(0.41)	(-3.16)	(-1.41)	(-0.45)	(-3.91)	(-2.32)
XE_{-1}	-217.90**	-969.57***	-832.43*	-481.16	311.28	452.65
	(-2.52)	(-3.60)	(-1.90)	(-1.25)	(1.11)	(1.07)
ηXE	-1.21	-0.40	-0.38	NR	NR	NR
N	49	49	49	49	49	49
Adj. R^2	0.97	0.96	0.95	0.97	0.99	0.99
Breusch-Godfrey χ^2	2.17	3.12*	4.18**	2.55	15.07***	16.10***

Sources: Federal Reserve Board, Moody's Analytics, and Smith Travel Research.
Note: This table presents OLS estimates of coefficients for determinants of U.S. hotel demand by chain scale using data from 2000 Q1 through 2012 Q1. The dependent variable is D–Number of rooms sold (demand). The following variable identifiers apply: RPI–Real personal income, EMP-Total employment, RADR–Real average daily rate, Q1-Q3–Quarterly dummies, XE–FRB Broad Index, and ηXE–Elasticity of XE (reported when XE is significant). t-statistics in parentheses and * indicates significant at the .10 percent level, ** at the .05, and *** at the .01 level. χ2 statistic (d.f.=1), * indicates significant at the .10 percent level, ** at the .05, and *** at the .01 level. NR – Not reported. Adjustment for autocorrelation when Breusch-Godfrey χ2 exceeds critical value.

Overall, the regression results in Exhibit 6 for the six chain scales resemble those obtained with the national data. As with the national hotel demand regressions, we generate estimates by OLS and make adjustments for autocorrelation as needed. The coefficients on exchange rate are insignificant for the three chain scales in the lower tiers; and correctly signed and significant for the three upper-tier hotel chain scales. The elasticity estimates of -.38 through -1.21 indicate that a ten percent change in exchange rates generates as much as a 12 percent change in the number of hotel rooms sold among higher quality hotels in the U.S. This means, for example, that the year-over-year decline in the FRB Broad Index of approximately nine percent that occurred during two quarters of 2008 led to tens of thousands of additional hotel rooms sold nationally in the higher quality tiers per day during those quarters.

Disaggregating the national data by chain scale reveals that the effect of exchange rates on hotel demand in the U.S. is concentrated among the higher price and quality hotels in the U.S. With an elasticity of -1.21 the luxury segment appears particularly sensitive to exchange rate movements. Also, the effects of movements of exchange rates on hotel demand are somewhat masked from regression results using national data as indicated by larger elasticity numbers for the top three chain scales relative to the national elasticity reported in Exhibit 5. Hotels counted among the top three chain scale segments only constitute about ten percent of the total number of properties and rooms in the U.S., however these hotels are highly visible and economically important to the cities in which they operate. In addition, many prominent independent hotels would be included in the luxury and upper-upscale categories if they were chain affiliated. We believe that the sensitivity of demand to exchange rates for these independent hotels would closely align with the sensitivities we find from the chain scale regressions.

4.3 Gateway City Results

The motivation for singling out U.S. ‘gateway’ cities is to test the hypothesis that a currency exchange rate effect on hotel demand is most pronounced in local markets that attract relatively more and different types of international visitors. For example, New York, Miami, and Los Angeles rank one, two, and three in international enplanements among major U.S. cities in 2011; far out distancing most other U.S. cities ranked among the top 25 cites (U.S. Department of Transportation, 2012). Further, we conjecture that the type of traveler differs in each city with

New York and Washington receiving proportionally more business travel relative to, say, Miami. Thus, we analyze hotel and economic performance data by city to determine if disaggregation of the national and chain scale data along spatial dimensions provides additional insights about the effect of currency exchange rates on U.S. hotel demand. In the absence of either institutional or academic determinations of what constitutes a 'gateway' city, we rely on a definition and classification of gateway city orientated to local hotel markets developed by Corgel (2012). The definition is as follows:

> **hotel gateway city** 1. A city that serves as a departure or arrival point for international travel regardless of either transportation mode or country of origin and destination. 2. A city in which international tourism is meaningful to the local hotel market.

This classification approach leads the following locations qualifying as hotel gateway cities: Boston, Chicago, Honolulu, Los Angeles, Miami, New York, San Francisco, and Washington.

As discussed in the previous section, our demand model estimations for gateway cities are performed at two hotel price tiers – upper price and lower price. This division aligns closely with the traditional notion of organizing hotels into full service and limited service categories as well as a division of chain scales with luxury, upper-upscale and upscale constituting the upper-price tier and upper-midscale, midscale, and economy making up the lower-price tier. The main distinction here is the inclusion by Smith Travel Research of independent hotels into the price tiers at the city level.

The regression results reported in Exhibit 7 (upper-price hotels) and Exhibit 8 (lower-price hotels) differ in minor ways from results obtained with the national and chain scale data. In seven of the eight gateway city upper-price hotel regressions the exchange rate coefficient has the correct sign and is statistically significant, Honolulu being the exception. The elasticity estimates range from a low of -.77 in Washington to a high of -1.25 in Miami. These estimates well exceed those reported for the U.S. and are higher as a group compared to the chain scale elasticity estimates. Consistent with our findings from the chain scale analysis, the exchange rate coefficient is negative and significant in only one half of the lower-price segment of gateway cities – Honolulu, Miami, New York, and San Francisco. In these cities, the elasticity estimates are generally in line with those for upper-price hotels indicating no meaningful distinction in hotel preferences by international travelers among price tiers.

5. Conclusion

Modeling hotel room demand begins with price (*i.e.,* average daily rate), and dominant measures of macroeconomic and local economic strength, principally income and employment. These variables along with seasonal adjusters and a lagged dependent variable (*i.e.,* with a partial adjustment model) typically explain a large percent of the variation in the number of rooms sold over time in the nation and across local markets. Other determinants can incrementally contribute to explaining hotel demand and even have meaningful influences on demand. We investigate the incremental contribution of currency exchange rates to the number of rooms sold as an independent effect on aggregate hotel demand. The null hypothesis tested here is that international travelers are indifferent to currency exchange rates and therefore mainly travel in response room rates, other travel expenses, and seasonal preferences.

Our findings have some dominant themes. First, we demonstrate that evaluating currency exchange rate effects on hotel demand at the national level of aggregation masks some of the effects across different price/quality tiers and cities. Second, when examining disaggregated data we find that only demand among upper-price hotels, particularity luxury, and also upper-upscale and upscale hotel chain scales, is sensitive to currency exchange rates. Third, significant statistical relationships between currency exchange rates and hotel demand are particularly strong among U.S. gateway cities. The estimated demand elasticity with respect to currency exchange is greatest for all but one of eight gateway city destinations for international travel, but predominately among travelers that stay in upper-price hotels. In only one half of these cities does the exchange rate have some influence on demand among lower-price hotels. Our elasticity findings confirm that international travelers to U.S. destinations respond quite differently to currency exchange rate movements, sorting themselves out by type of hotel and destination.

A limitation of this study comes from the inability to separate rooms directly sold to international travelers from the total number of rooms sold. Data provider Smith Travel Research does not segment demand by country of origin and to our knowledge only proprietary time-series data exist on market-wide hotel stays by international travelers. Therefore, our analyses are performed using total demand numbers. Future research is needed to test for currency exchange rate effects with traveler data indicating the country of origin and the destination within the U.S. Additional controls then would be put into place for economic conditions in the country of origin.

Also, the results we generate from estimating aggregate demand equations indicate net changes in U.S. hotel rooms sold due to currency exchange rate movements from domestic and international hotel occupancy. We cannot measure the extent to which domestic travelers substitute domestic travel for international travel during periods of unfavorable exchange rates.

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