The U.S. Lodging Industry: An Econometric Analysis

by

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ABSTRACT

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Submitted to the Department of Urban Studies and Planning on August 11, 1995, in Partial Fulfillment of the Requirements for the Degree of Master of Science in Real Estate Development

This thesis is an attempt to assist developers and investors with making knowledgeable decisions about when to build or invest in the U.S. lodging industry. A 26 year, quarterly time series data set on the industry was econometrically analyzed to better understand the market behavior, cycles, and the major influences on demand and supply. Four stochastic and three identity models were created.

First, room absorption was determined as an adjustment model whereby the change in the number of rooms sold is primarily a function of GDP and to a lesser extent real average room rates and domestic enplanements. This model was found to adjust fairly quickly towards its target room absorption and the price elasticity of room demand was found to be inelastic.

Second, the change in the real average room rate was determined primarily by an elastic relationship with the occupancy rate and to a lesser extent inflation rates. This model found that average room rates adjust very slowly over time.

Third, construction was modeled primarily as a function of the existing room stock and real average rates; and to a lesser extent, interest rates, room rate inflation and room absorption. This model demonstrated that construction levels adjust very quickly to market changes. The relationship between room rates and construction and room rates and total room stock were shown to be very elastic.

Finally, room scrappage or demolition was modeled as a function of the annual change in real GDP, real average room rates, construction and real interest rates. Scrappage was shown to have a very elastic relationship with the average room rate.

Furthermore, most of the models demonstrated that decisions for the hotel industry are based on market behavior from last year versus last quarter.

The thesis concludes with the stock/flow model analyzing two 10 year forecasts beginning in 1995. The first scenario maintained interest rates and inflation at current levels and forecasted GDP and enplanement growth at 2.5%/year and 1%/quarter respectively. The second scenario introduced a recession and subsequent recovery starting in mid-1997.

Both forecasts indicated that now is an opportune time for investment because the lodging industry is about to enter a conservative construction phase induced by higher room and occupancy rates.

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Introduction

Statement of the Problem

In the past decade the United States lodging industry has experienced one of its biggest booms and subsequently, one of its worst busts in history. Room rates have declined, occupancies have plummeted and development has come to a virtual standstill. In 1991 alone, it was estimated that the lodging industry lost $5.2 billion[1]. Though over-supply was apparent in the late 1980's, active development continued into 1992, compounding this problem until occupancy declined to a low of 60.2%[2]. Only recently has there been renewed interest in hotel development.

Hotel industry analysts are now trying to forecast the prospect of investing into the lodging industry. The question now is when should new development begin again? How can better predictions be made? What kinds of exogenous factors contribute to the uncertainties of the lodging industry?

Purpose of Study

Hotel development is an involved and complicated process where timing is critical. This thesis is intended to track and analyze time series data of the United States lodging industry and create an econometric stock/flow model. Through this data analysis, cyclical movements of the lodging industry can be tracked and the behavior of the lodging market understood. The principal variables of lodging supply and demand can be identified and their elasticities investigated. With this cognizance of the lodging industry, the model will be effective for forecasting future demand, rates, and stock of hotel rooms given a

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[1] Coopers & Lybrand, "Lodging Industry Losses to Decline 4.1% in 1992 from $5.2 Billion in 1991, as Economy Slowly Recovers", *Hospitality Directions*, Vol. II No. III, Fall 1992, p.6

[2] Stephen Rushmore, "An Overview of the Hotel Industry: Past, Present, and Future", *The Real Estate Finance Journal*, Vol.9/No.4 Spring 1994, p.7

forecast of the national economy, general economic conditions and domestic airline passengers.

This study was conducted on the United States lodging market as an aggregate to determine trends in the industry. The specific model and data apply to the United States as a whole. With regional modification, more micro level forecasting should be possible.

Thesis Organization

Chapter 1 begins with a brief description of the United States lodging industry and an introduction to frequently used lodging industry terminology. The chapter then presents previous research, focusing on two prior studies: Coopers & Lybrand and Salomon Brothers. The lodging industry real estate cycle is then described and a general description of the model's methodology and structure is explained. Finally, a table listing the variables used in the subsequent models is presented.

Chapter 2 focuses on lodging industry demand. The chapter begins by identifying the factors affecting demand and introduces the reader to the general data. The chapter then proceeds to develop the demand side econometric models and analyzes the results from the 26 year data series.

Chapter 3 repeats Chapter 2's structure but from a supply side perspective. The reader is introduced to the factors affecting the supply side of the lodging industry and the general data. The chapter continues with the development of the supply side lodging econometric model and analyzes the results from the 26 year data series.

Chapter 4 combines the demand models developed in Chapter 2 and the supply models developed in Chapter 3 with two forecasts of the exogenous variables. Scenario A forecasts steady moderate growth in GDP and domestic enplanements and maintains inflation and interest rates at current levels. Scenario B maintains the same forecasts as Scenario A for enplanements, inflation rates and interest rates but introduces a recession and subsequent recovery in GDP starting in mid -1997. Thereafter, the number of rooms sold (demand), completed (construction), and scrapped (demolished) are forecast as well the average room rates, occupancy rates and room stock (supply) for the next ten years. It will be shown that regardless of which scenario is accepted, now is a good time to invest into the lodging industry. This recommendation is concluded from forecasts that predict that the lodging industry is on the cusp of a moderate development period, spurred on by rising room rates.

Description of the United States Lodging Market

The United States lodging industry is estimated to be worth over $200 billion in assets. Altogether there are approximately 3.2 million guestrooms, in over 40,000 establishments, which generate a total quarterly industry revenue of over $73 billion dollars[3] or over 1% of the Gross Domestic Product.

There are many ways of describing hotel properties. Classification systems abound but the most popular classifications are by class, type, and location. Class rating is a combined assessment of the property's quality and staff service. Type classification refers to the physical attributes of the property. Lastly, location classification refers to the market to whom the property is catering. Stephen Rushmore of Hospitality Valuation Services, an international hospitality appraisal and consulting firm, outlines the classifications in his book *Hotel Investment, A Guide for Lenders and Owners* as follows:[4]

[3] Coopers & Lybrand, "Coopers & Lybrand 12 Quarter Lodging Forecast", *Hospitality Directions*, Vol.III No.1, Winter 1993, p.11.

[4] Stephen Rushmore, *Hotel Investments, A Guide for Lenders and Owners* (Boston-New York, Warren Goreham & Lamont, Inc. 1990), p.3-2-3-7

Table 1.1 - Property Classifications

Method	Classification	Method	Classification
Class	Luxury First-Class Standard (mid-rate) Economy(budget) Microbudget	*Type*	Commercial Convention Resort Suite Extended Stay Conference Center Microtel Casino Bed & Breakfast Inn Ma & Pa Motel Boutique Hotel Health Spa Boatel
Location	Airport Highway Downtown Suburban Convention Center Resort Mixed-Use		

For the purpose of this study, all hotel types, regardless of the classification system, were used.

By not discriminating as to hotel type, biases that may be present in the data can be mitigated. For example, the demand equation for an airport hotel could vary greatly from that of a resort because of various exogenous factors. Including all hotel types and using general exogenous data, avoids classification biases for they are averaged and theoretically offset each other.

Previous Studies

In mid-1991, Coopers & Lybrand introduced their United States Lodging Econometric Model in their quarterly publication *Hospitality Directions*. Coopers & Lybrand uses their model for three purposes.

The model primarily focuses on statistically forecasting the lodging industry. Second, the model is used as a means of understanding the market behavior of the lodging industry and its relationship to the general economy. Third, the model is utilized to assess the impact of various long term economic scenarios on the lodging industry.

Coopers & Lybrand's lodging data base is organized quarterly and contains data on most key lodging variables from 1967 to the present. The data is a compilation of information from various sources including F.W. Dodge, Smith Travel Research[5], the Census Bureau, the Bureau of Economic Analysis and industry publications. Cooper's & Lybrand kindly provided a copy of their time series data set for use in this study.

The Coopers & Lybrand quarterly lodging model includes three stochastic equations representing room demand, the percentage change in average daily rate and construction starts. Using accounting identities based on the three equations eighteen additional indicators are calculated. The model is estimated using the ordinary least squares method over the life of the data base.[6]

In a 1995 report, Coopers & Lybrand assessed the performance of their model using the average absolute percent error and root mean square percent error methods. The average absolute error is defined as the sum of the difference between the simulated errors and actual errors divided by the actual errors value for the appropriate period. The root mean square percent error is defined as the square root of the sum of the squared errors divided by the actual error value in each period. They reported that when the model was simulated from 1987 Q1 through the 1991 Q4 both prediction errors were less than 3% of most key variables.[7]

Coopers & Lybrand concluded from their model that 99% of the variation in the number of rooms sold is attributable to changes in real Gross Domestic Product and real room rates.

GDP was the major determiner and it appears that the lodging industry adjusts to economic growth with a four period lag and that the yearly GDP elasticity of demand is 1.3[8].

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[5] Smith Travel Research performs a monthly survey of 12,000 to 13,000 lodging properties and publishes the findings in its own *Lodging Outlook* newsletter. They also maintain a database with profile information on over 27,000 hotels.

[6] Coopers and Lybrand, "Econometric Forecasting, Understanding the U.S. Lodging Industry", (Coopers and Lybrand 1995) p.1

[7] Ibid p.3

[8] Ibid p.4

They also concluded that average daily rate's effects on the number of rooms sold is small. Their calculated price elasticity of demand for the aggregate United States was only 0.39[9]. This low elasticity was argued to be due to the lack of a substitute product for hotel rooms.

Regarding the average daily rate, Cooper's & Lybrand determined that occupancy was the primary influence. For example, if the occupancy declines, hotel operators lower rates to attract more business.

In their third stochastic equation, they calculate hotel room starts as a room adjustment process. Because construction is not instantaneous, the adjustment takes several periods to be completed. Though using room completions is technically the correct way to measure the room stock change, they feel that room starts are more closely related to the economy. In their equation, the average daily rate was identified as the key variable driving construction with an elasticity of 7.3[10].

Overall, the Coopers & Lybrand U.S. Lodging Model has a successful track record for forecasting and analyzing the United States lodging industry. It is updated quarterly, as are all projections made from the time series.

A second statistical lodging model was also reviewed. In mid-1991, Salomon Brothers created a demand-forecasting model based on three key variables; real Gross National Product (GNP), gasoline prices and the dollar exchange rate.

They also concluded that real GNP was the dominant indicator of lodging demand growth. Gasoline prices and the dollar exchange rate were less influential and were negatively correlated with lodging demand. [11]

Simply stated, as fuel prices increased, the cost of automobile and airline travel increased, hence less people traveled and the demand for lodging rooms decreased.

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[9] Coopers and Lybrand, "Econometric Forecasting, Understanding the U.S. Lodging Industry", (Coopers and Lybrand 1995) p.5

[10] Ibid p.7

[11] Margo L. Vignola and Jill S. Krutick, "U.S. Lodging Industry on the Rebound", Salomon Brothers Stock Research, May 1991, p.6.

As the dollar strengthens, more Americans travel abroad and less foreigners travel to the U.S. hence the demand for hotel rooms decreases.

The model seems to have been discontinued for there is no mention of this model in recent Salomon Brothers lodging research[12]. Therefore, any historical predictor quality could not be determined.

With regard to additional previous research on econometric lodging forecasting, the industry research from most of the premier hospitality and lodging consulting, management and accounting companies was reviewed. No additional, true statistical analysis or forecasting that is used on a continuous basis could be found. It appears that most forecasts for the future demand of the lodging industry are based on trend-line extrapolation related to the Gross Domestic Product versus any type of true econometric methodology.

This trend analysis is inferior to the contingent economic forecasting being employed by Coopers & Lybrand and in this paper. These other companies' forecasts are only statistically related to time and based on a third party's forecast of Gross Domestic Product. There are additional variables, other than Gross Domestic Product, that influence the hotel industry and therefore, must be considered. These variables include the number of people traveling, interest rates, inflation and construction costs. Each variable not only has its own elasticity with respect to the lodging industry but also interacts with each other.

Because these influences can move independently of each other, short term variations are often not evident. Usually with trend analysis, only a long term trend can be forecast and any short term oscillations from this trend will be missed. These oscillations can translate into millions of dollars saved or lost.

Related to this missing of trends, cyclical fluctuations in the industry can also be missed. The lodging industry, like all industries, cycles through peaks and troughs. By only analyzing trends, an overall "average" is forecast. This average ignores the cyclical fluctuations that can optimize an investment.

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[12] The most recent major research being: W. Bruce Turner, "The Lodging Industry - Recovery May Be Here for an Extended Stay", Salomon Brothers Equity Research, October 11, 1994.

Alternatively, by ignoring the cyclical fluctuations of the industry, an investment at an inopportune time (i.e. at the peak of the cycle) may be made.

Methodology of Study

Study Area

The area for study is the United States of America. This includes all fifty states but excludes any territories or possessions.

The United States as a whole was chosen for numerous reasons. First, data for the whole United States is readily available when compared to data for a region or a foreign country. Second, by choosing the entire United States, regional attributes that may skew the data can be mitigated. Additionally, regional economic influences can be avoided.

Time Frame

Data for this model was collected for a twenty-six year period (1969-1994) which allowed for observations over four business cycles.

Additionally, each year was reported on a quarterly basis which provides for a maximum of one hundred and four observations.

Property Types

This model was constructed to include all hotel types and sizes. No specific hotel type was excluded[13].

By using the entire lodging market, specific attributes associated with one type of hotel that may skew the data can be mitigated.

Furthermore, influences from increases or decreases in one type of hotel such as the 1980's increase in all-suite hotels can also be avoided.

The Lodging Industry Real Estate Cycle

All real estate markets operate on the fundamental principles of supply and demand. In the lodging industry, demand can be defined as the number of

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[13] See Table 1.1.

rooms occupied and supply can be defined as the number of rooms available. Because vacant hotel rooms are instantly obsolete (unsold hotel rooms are unrecoverable), finding an equilibrium between the two is imperative.

A logical question then to ask is why hotels have so many vacant rooms? The lodging industry is a seasonal business because travel is seasonal. This means that during certain months the number of travelers increases, while in others it decreases[14]. In some markets, this seasonality can cause occupancy to vary by 40%. Because rooms cannot be inventoried, hotels are built with supply trending towards the peak demand times in order to maximize revenues. This equates to a large percentage of hotel rooms that are vacant during non-peak periods. If this vacancy is averaged over the entire year, a structural vacancy emerges.

A fundamental problem exists within the lodging industry concerning the demand/supply balance of hotel rooms. For the lodging industry, demand changes daily. Conversely, supply adjustments takes much longer. With these different adjustment rates a real estate cycle emerges triggered by changes in the occupancy rate.

At the beginning of a real estate cycle, we start with a level of hotel room stock and a structural vacancy. The room rate is based on the availability of rooms in the marketplace combined with an option component. The option component is the value associated with leaving the room vacant for a potential higher paying guest versus renting the room now.

The room rate multiplied by the number of available rooms and the occupancy rate determines a total room revenue. This room revenue is then translated into property prices in the asset market[15]. These asset prices will generate new construction if, and only if, they are higher than the cost of constructing a new property. This new construction eventually yields a new, higher level of stock.[16]

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[14] See the section on seasonal adjustments for a full discussion.

[15] Room revenue was focused on because of the high contribution margins to net operating income as compared to non-room revenue.

[16] Denise DiPasquale and William C. Wheaton, *The Economics of Real Estate Markets*, (Prentice Hall 1995), p.1-15.

As new hotel construction occurs and the stock of hotel rooms rises, occupancy begins to decline which causes the room rates to decline. Eventually, this lowered room rate equates to a lower asset value. This lower asset value gradually reduces the construction rate. Ultimately, the construction cost surpasses the asset value and new construction will cease. Due to the inherent lag of constructing new hotels, new room stock is still entering the market for approximately one and a half years after new construction has stopped. This additional over supply of rooms further depresses room rates which in turn equates to even lower asset values.[17]

With no new construction, the hotel stock slowly decreases due to scrappage (economic obsolescence). As the stock of hotel rooms decreases, occupancy rates increase and with it real average room rates. Additionally, occupancy increases can also come about from a gradually expanding economy. Regardless of the reason, this increasing room rate increases the asset prices. Ultimately, room rates rise until the asset value surpasses the replacement cost and construction begins anew.

Description of Model

The lodging industry econometric model that was created for this study is comprised of four behavioral equations and three accounting identity equations. The interrelation among the seven equations is illustrated as a flow diagram in Chart 1.1.

The first equation to be presented is an identity equation used for updating the total room demand (ROOMS SOLD) in each period. It states that the demand this period is equal to the change in room demand (room absorption) added to the to the demand in the previous period.

As will be discussed in Chapter 2, the room demand in a period is dependent on two main factors: people's propensity to travel and the ease at which this

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[17] Denise DiPasquale and William C. Wheaton, *The Economics of Real Estate Markets*, (Prentice Hall 1995), p.10-10-10-19.

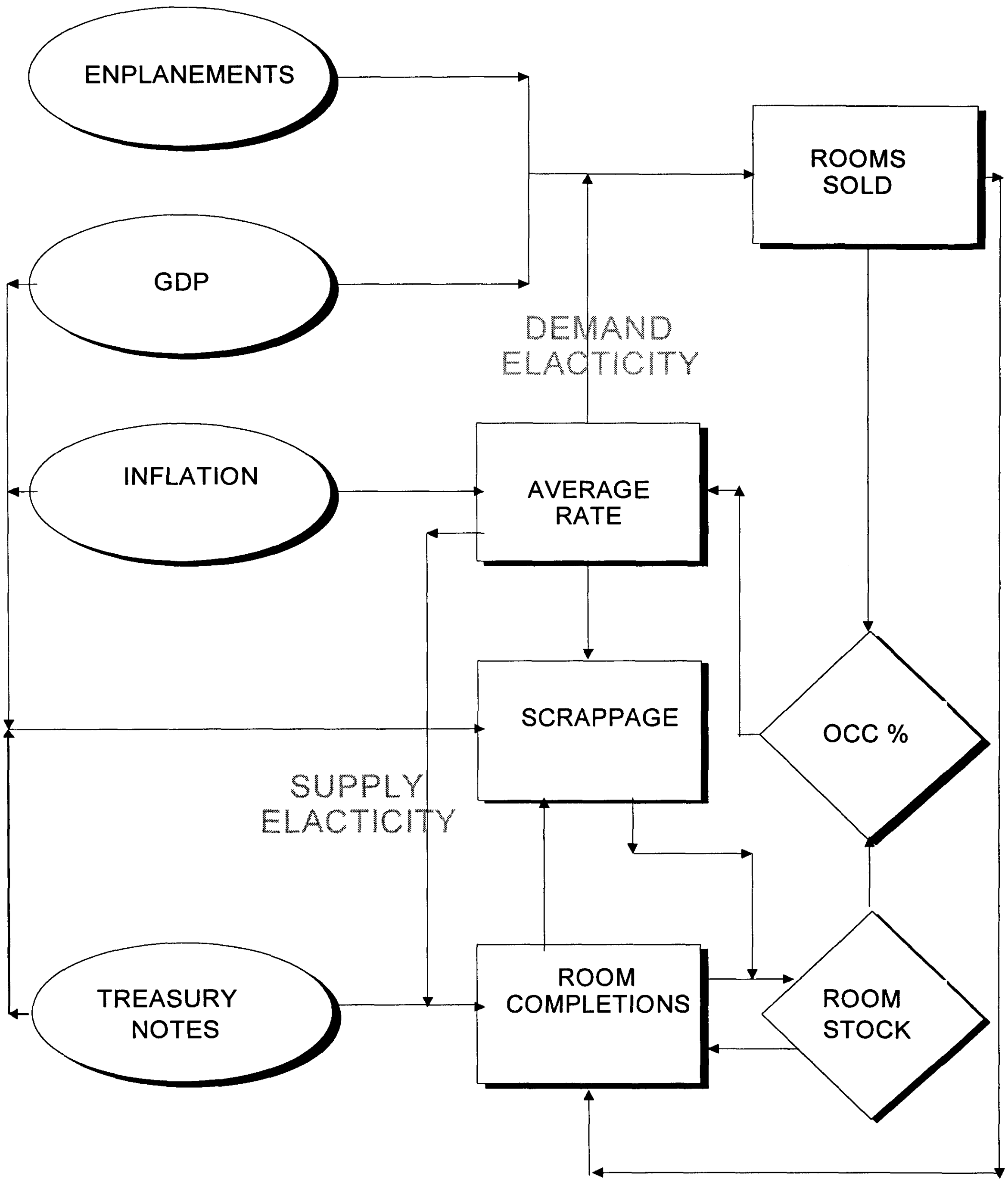
travel can be accomplished. For example, if people are more inclined to travel due to low room rates or air fares, demand for rooms increases. Room demand will therefore be identified as a function of the endogenous variable, real average room rates and two exogenous variables: the economy (GDP) and the number of domestic airline passengers (ENPLANEMENTS).

This room demand is used in a second identity equation for determining the occupancy rate. The occupancy rate is calculated as a ratio of the room demand (ROOM SOLD) to the room supply (ROOM STOCK).

The average room rate is then calculated as a function of the occupancy rate and the exogenous variable of inflation.

With this forecast of average rates, the number of room completions (construction) can be determined. Room completions will be determined as a function of the following endogenous and exogenous variables: existing room stock (supply), the average room rate, the changes in this average rate, the change in the number of rooms sold (room absorption), and interest rates (treasury notes are used as a proxy). These variables represent the two main influences on construction: demand and financing.

Chart 1.1 - Lodging Industry Econometric Model Flow Diagram[18]



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[18] Key
⬭ Exogenous Variable
▭ Endogenous Variable
◇ Identity

The final stochastic equation determines scrappage which will be shown to be a function of a property's existing and potential revenue earning capabilities. These capabilities are based on economic conditions (GDP, interest rates and inflation) and the aforementioned room completions (new construction).

Finally, the third accounting identity updates the room stock (total supply) by taking last period's stock, adding any room completions and subtracting any scrappage. This new room stock, in turn, influences the number of room completions and the occupancy rate.

By combining the four econometric models with the three identities, a full stock flow model can be constructed and lodging industry forecasting can be performed. The complete model is recursive which means that information from a previous period determines this period's data which in turn determines next period's data and so on.

Glossary of Key Variables

Table 1.2 presents the codes and definitions of the key variables used in the econometric model that will be developed in Chapters 2 and 3 and forecasted in Chapter 4.

Table 1.2 - Key Variable Definitions

ABBREVIATION	*DEFINITION*
OC	Occupancy Rate
R	Real Average Room Rate
C	Room Completions (Construction)
AB	Change in Number of Rooms Demanded or Sold Between two periods (Absorption)
SOLD	Number of Rooms Sold
S	Rooms Supply or Available (Stock)
ENPLANE	Domestic Enplanements
GDP	Gross Domestic Product ($1990)
δ	Scrappage (Demolition)
TNOTES	10 Year Treasury Note Rates
INF	Real Inflation Rate
REALRATE	Treasury Note Rate minus the Inflation Rate
$_{(t)\ (t-1)\ (t-4)}$	Subscripts Designating Time Periods
Δ	Prefix Designating Yearly Change in Corresponding Periods
%DIFF	Suffix Designating the Yearly Percentage Change from Corresponding Periods

CHAPTER 2

Demand

This chapter is devoted to the subject of demand for the U.S. lodging industry. In the first section, the 26 year time series data is presented and the determinants of demand are identified. Interaction between endogenous and exogenous variables is examined as is the interrelationship between endogenous variables. With this information, an econometric model for demand is subsequently developed. The time series is processed and the chapter concludes with an analysis of the results.

Factors Affecting Demand for Hotel Rooms

National hotel room demand depends on two primary factors: people's propensity for travel and the ease at which this travel can be done. These factors are primarily affected by exogenous influences including economic, geographic, political, technological and seasonal. The issue at hand is whether it is possible to develop an econometric model that will accurately forecast this demand as these variables change.

Economic

Most lodging industry analysts believe that the demand[19] for hotel rooms tends to track the state of the national economy. Because the entire United States lodging market was observed as opposed to a region or metro-area, correlation with national macroeconomic trends is apparent. The fluctuations associated with local or regional economies seem to cancel each other. The basis for this hypothesis can be observed in the apparent correlations in Charts 2.1 and 2.2 and will be statistically verified in the subsequent model. Gross Domestic Product[20] is used as a proxy for the national economy comparisons.

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[19] Demand is defined as the number of guest rooms sold during a given period.

[20] GDP was compiled from the *International Financial Statistics Yearbook* published by the International Monetary Fund. It is defined as the sum of final expenditures: Exports of Goods and Services, Imports of Goods and Services, Private Consumption, Government Consumption,

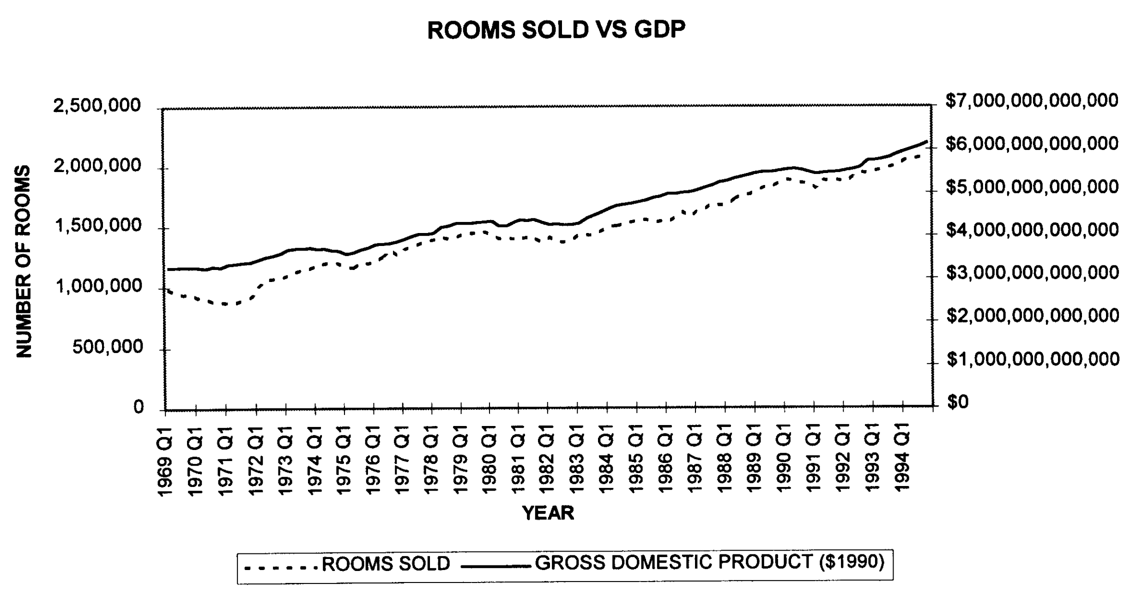
Chart 2.1 shows that in the long run, hotel demand (the number of rooms sold) tends to track the real Gross Domestic Product (GDP). Where GDP increased 89% in real terms over the 26 year period, the number of rooms sold increased 118%.

For short term observations, the historical fluctuations in lodging demand also tend to synchronize with the changes in real GDP (Chart 2.2). This is logical for people's propensity for travel is generally influenced by the state of the economy.

For the business traveler, companies tend to increase their workforce travel in expanding economies. This may be due to increased sales efforts or meetings. Conversely, in recessing economies, companies tend to cut expenses and travel is rated as the third largest corporate expense.

In the leisure market, expanding economies employ more people who in turn have vacation days. Alternatively, in recessing economies, disposable income decreases and layoffs occur, both of which translate as a decrease in leisure travel. This decrease in demand is blatantly apparent during the recessions of the mid 1970's, early 1980's and early 1990's.

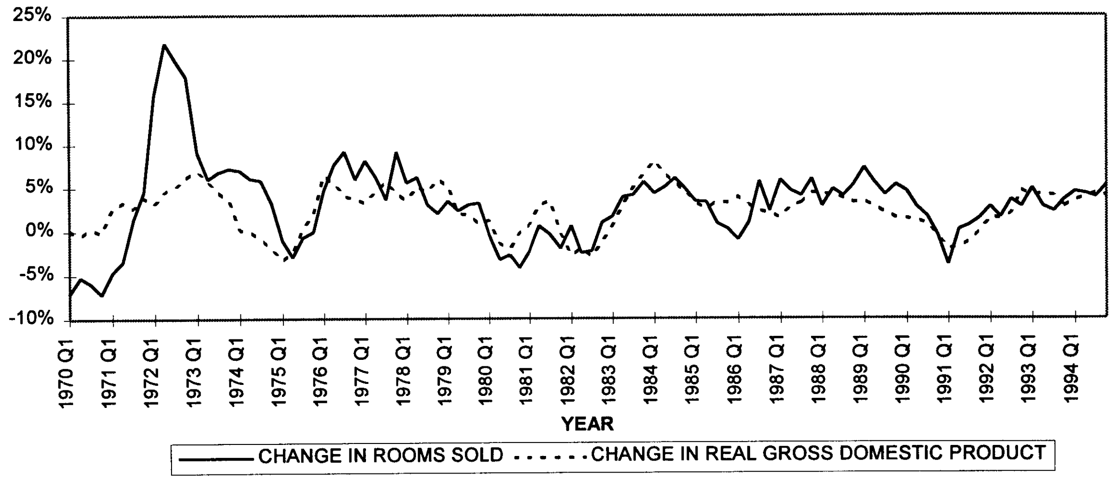
Chart 2.1



Gross Fixed Capital Formation and Increase/Decrease in Stocks. Amounts are presented in $1990.

Chart 2.2

ANNUAL CHANGE IN HOTEL DEMAND VS ANNUAL CHANGE IN REAL GDP

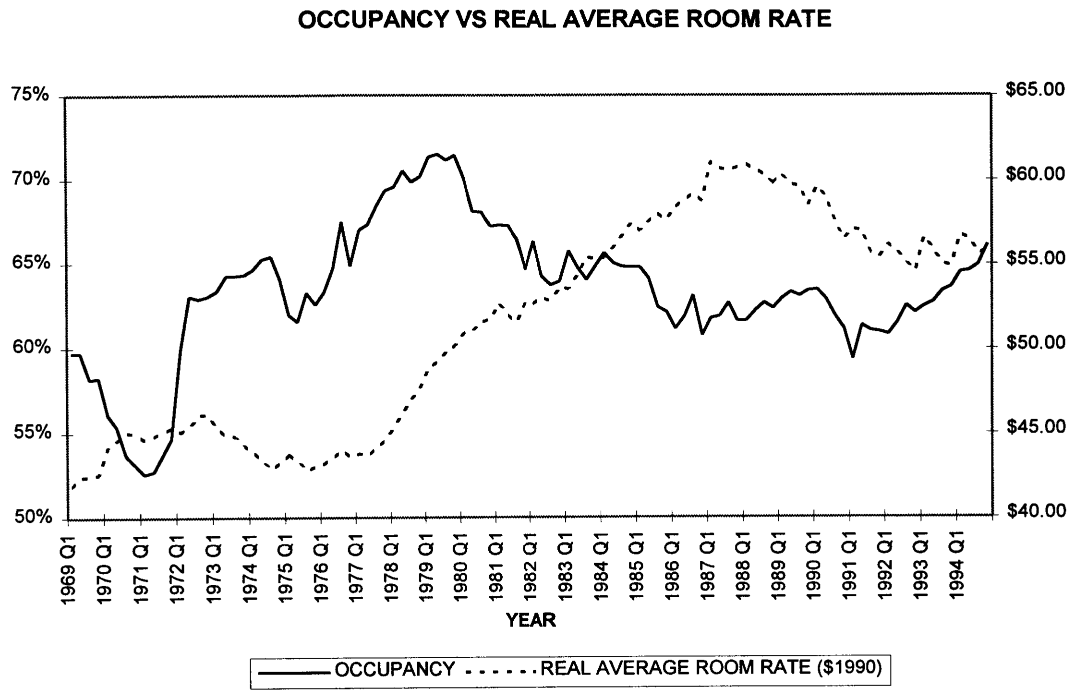


Demand, when compared to supply, determines the occupancy rate[21]. Occupancy then influences the average room rate which in turn, influences the room demand. The circular relationship between these variables requires that a balance be achieved between the occupancy and average room rate.

For the long term, the historical negative relationship between room rate and occupancy can be observed in Chart 2.3. As can be seen, the real average rate increase from the late 1970's through the late 1980's was met with a similar but opposite decrease in occupancy. The building boom that was associated with the capitalization of high room rates ended with the 1987 tax changes. The oversupply and low occupancy rates forced hotel operators to decrease their real room rates from 1988 through 1991 in order to increase occupancy. It was not until early 1992 that occupancy's turn around was apparent and room rates could cautiously begin to rise.

[21] The Occupancy Rate can be defined as the percentage of available rooms occupied for a given period. This data was provided by Smith Travel Research via Coopers & Lybrand.

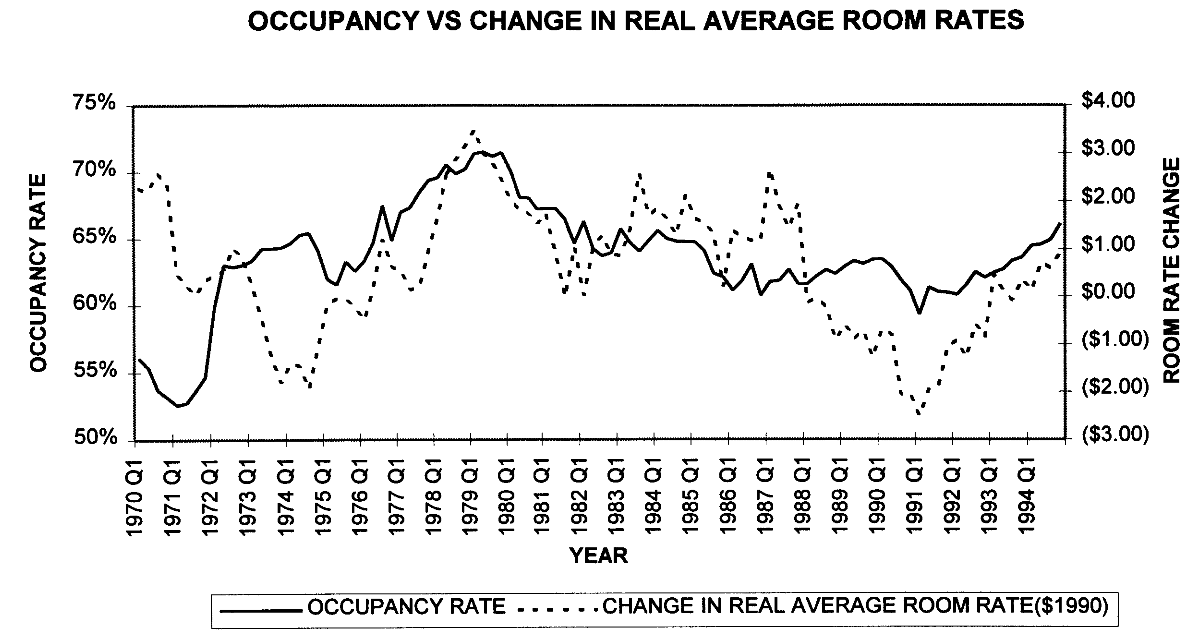
Chart 2.3



However, in the short term, Chart 2.4 illustrates that room rate adjustments are somewhat positively correlated with occupancy rates after 1975. As occupancy rates increase, the real average room rate increases due to demand. But, once the occupancy increase begins to taper off and turn downward, hotel operators begin to lower rates in an attempt to arrest this downward trend and hopefully reverse it.

Before 1975, the high inflation rates combined with an oversupply of hotel stock derailed the short term occupancy/room rate relationship. Again in the late 1980's and early 1990's, these two variables unhitched due to the oversupply and economic recession. It appears that post 1992, the correlation has corrected itself.

Chart 2.4



Inflation, as one of the economy's major components, seems to have an influence on the real average room rate. Economic theory argues that inflation's effect on the real average room rate should be neutral. Therefore, the room rate inflation should synchronize to the economic inflation. Referring to Chart 2.5, it is obvious that for the lodging industry this is not the case.

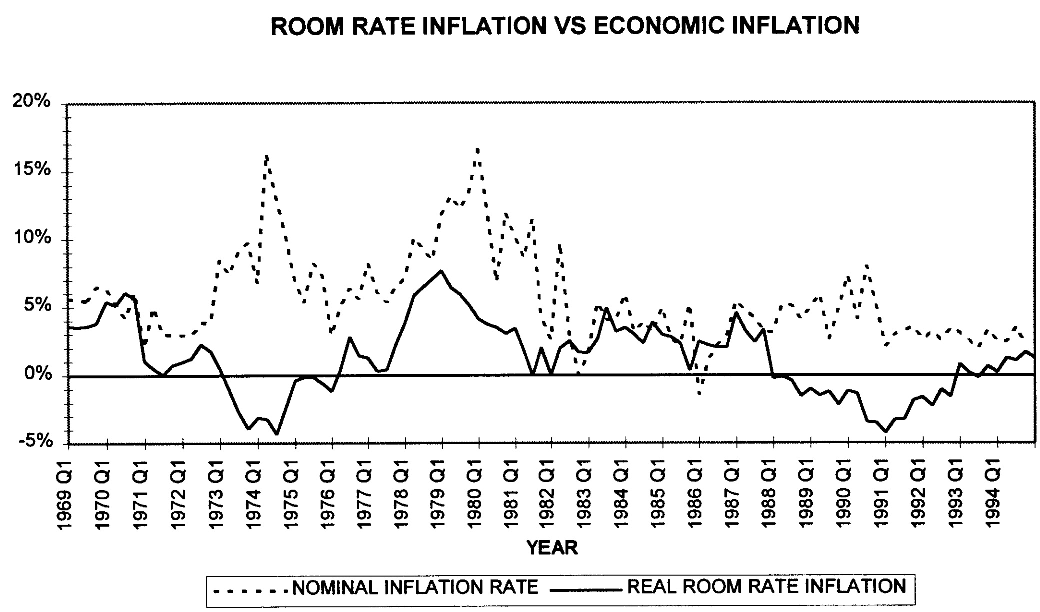
In Chart 2.5, the horizontal line at 0% represents the theorized neutral effect of inflation. If this theory was to hold true, the room rate inflation should also be a horizontal line at 0%. As can be seen, real room rate inflation oscillates on either side of this 0% line. The room rate inflation rate was less than economic inflation in both the mid-1970's and early 1990's. This means that the hotel operators were absorbing a part of the nominal cost increases which decreased their real average room rate. This room rate deflation occurred in both a high economic inflation period (mid-1970's) and a low economic inflation period (early 1990's). The effect of this on room rates is apparent back in Chart 2.3 where in real terms, hotel rooms are earning less revenue per occupied room in the 1990's than they were in the late 1980's.

Alternatively, hotel operators raised room rates higher than the inflation rate in the late 1970's and again throughout the 1980's. Consequently, their average room rate grew in real terms. Again, this increase happened in high inflationary periods, (late 1970's/early 1980's) and low inflationary periods (mid-1980's).

It could be theorized that the tendency for room rate inflation to be lower or higher than real economic inflation depends on occupancy levels combined with the interest rates. If the occupancy rate is high and nominal inflation is high, as they were in the late 1970's/early 1980's, hotel operators increase room rates faster than the economic inflation rate.

Alternatively, if occupancy is low an inflation is high or trending upward, hotel operators are apprehensive about raising room rates which, in turn, would further lower the occupancy rate.

Chart 2.5

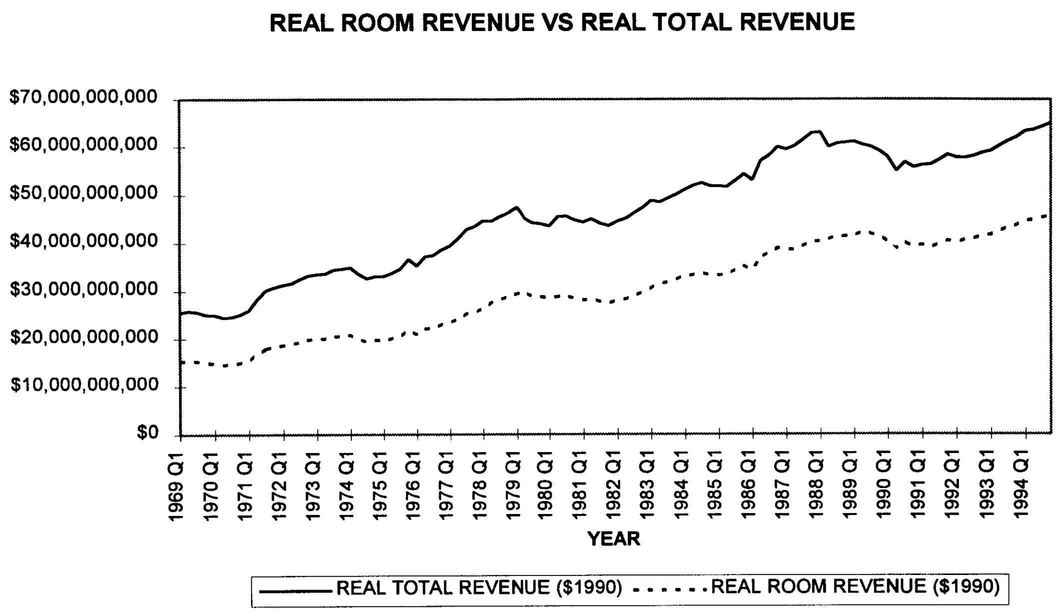


The aforementioned decrease in the real average room rate translates into less real room revenue[22] and subsequently total revenue[23](Chart 2.6) for a

[22] Room Revenue represents the total revenue earned from room sales only during a specified period. It can be calculated as an identity by multiplying the Average Room Rate by the total number of Rooms Sold for the same period. This data was provided by Smith Travel Research via Coopers & Lybrand.

lodging property. Because room revenue historically represents 65% of the total hotel revenue and has the highest contribution margin[24], any drop in the real room revenue has a significant overall effect on the profitability of the industry.

Chart 2.6



The strength of the U.S. dollar against other currencies also affects lodging demand. If the U.S. dollar is weak against foreign currencies, their will be an increase in foreign tourism to the United States, especially in the cities that tend to attract foreigners (e.g. San Francisco, New York, Boston). An increase in tourism means an increase in the demand for hotel rooms.

Alternatively, if the dollar is strong against foreign currencies, foreign tourists do not travel to the United States and the level of U.S. tourism to foreign countries increases. Both factors decrease domestic U.S. travel and consequently reduce lodging demand.

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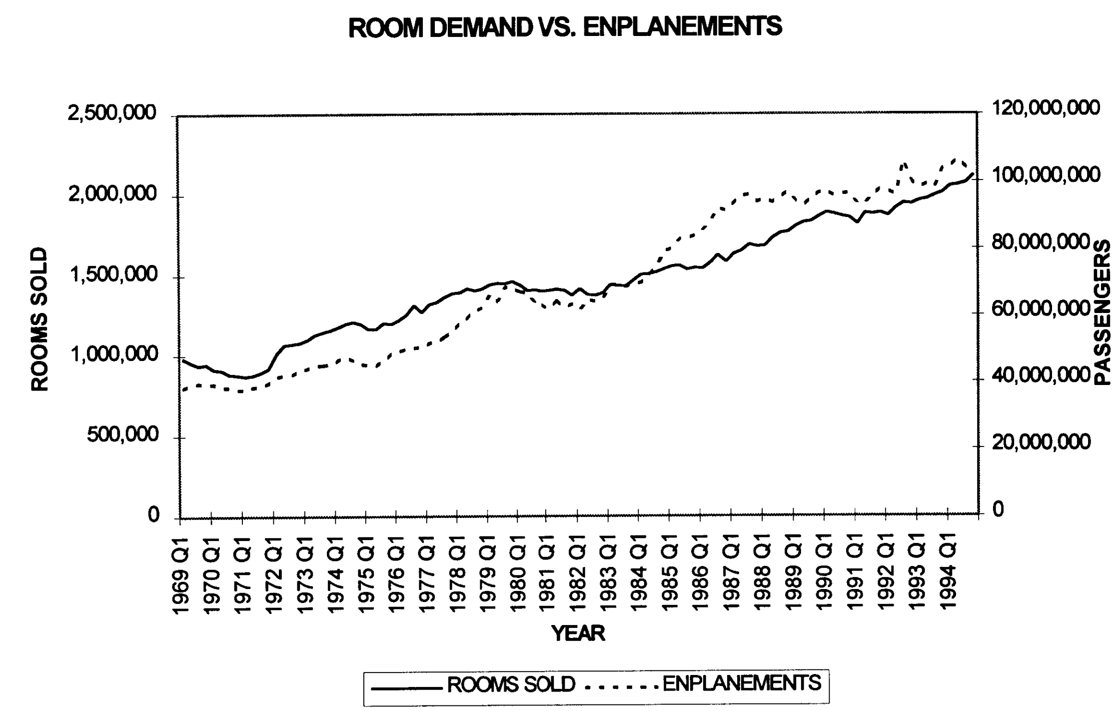
[23] Total Revenue represents all revenue earned from a hotel property during a specified period. This includes room sales and other revenue department sales such as food and beverage. This data was provided by Smith Travel Research via Coopers & Lybrand.

[24] The percentage of departmental income that contributes to Net Operating Income.

Technological

Technological advances in travel have a great effect on lodging demand. The increased use of the automobile in the 1950's gave rise to the roadside motel. The growth of the airline industry in the past thirty years has increased both domestic and international travel and thus increased lodging demand. While room demand has increased an overall 118% in the 26 year observation period, enplanements[25] have increased 181% (Chart 2.7). More travelers equate to more hotel guests and thus higher demand.

Chart 2.7



Political

Government policy can have both positive and negative effects on demand. For example, the deregulation of the airline industry decreased air travel costs causing air travel to increase and with it the demand for hotel rooms.

[25] Enplanements consist of all paying, domestic airline passengers. This data was collected from The U.S. Department of Transportation's *Air Traffic Statistics Monthly* for 1984-1994 and the Consumer Aviation Bureau's *Air Carrier Traffic Statistics* for 1969-1983.

Another example would be a local government's imposition of a hotel room tax which can adversely effect tourism and in turn the demand for hotel rooms. A room tax effectively raises the room rate to the end user and as presented above, occupancy and average rate are negatively correlated.

Historically, the oil embargoes of the 1970's or the Gulf War in 1991 had major negative impacts on the demand for lodging. Travel was difficult during these periods. Less travel equates to less hotel room demand.

Seasonal

The lodging industry has always tended to be seasonal. This means that the demand for rooms varies depending on exogenous factors such as the weather or holidays. These variances tend to be repeated at the same time every year. These seasonal variances make comparisons difficult within a property on a year to year basis or even a month to month basis. This seasonality also inhibits comparisons between different properties. Additionally, economic data such as GDP is reported seasonally adjusted, hence comparisons and analysis to non-adjusted lodging statistics are difficult.

These comparison problems can be solved through a process of seasonal adjustment. This process corrects for changes in the time series data that are solely attributable to systematic, periodic shifts in demand. In basic seasonal adjusting, a moving average is used to distribute the changes in the time series into three components:[26]

1. A trend component which represents the long term movement of the series.
2. A seasonal component which represents the intra-year cyclical movement.
3. An irregular component which represents random movement.

All data for this thesis has been seasonally adjusted. The benefits of seasonally adjusting data are apparent in the higher R^2's[27] achieved in all

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[26] Coopers and Lybrand, "A Note on Seasonal Adjustments", Hospitality Directions, Vol. II No. I, Winter 1992, p.12.

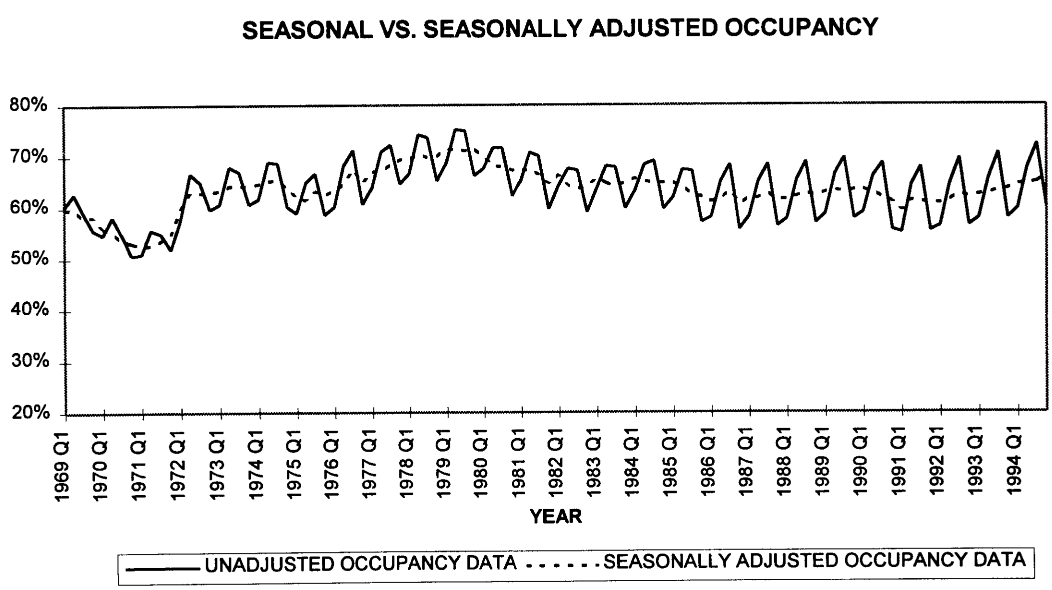
[27] R^2 can be defined as how well the data fits the linear regression equation.

stochastic equations. Chart 2.8 illustrates the difference between non-adjusted and seasonally adjusted occupancy data. As can be seen, the cyclicality associated with the seasonality adds "noise" to the data. The smoothed data allows the true trends to emerge which in turn provides better modeling results.

It is important to identify that the amplitude in occupancy's seasonal oscillation has increase over the past 26 years. The seasonal swing in the early 1990's appears to be twice that of the early 1970's. The reason for this increase is unknown. One theory would suggest that the modern airline fare structure (many rates vs a few rates) has amplified the seasonal travel patterns by attracting a larger population. Increased airline customers equate to more lodging demand.

Where seasonal adjustment is meant to average identical oscillations in subsequent periods, it is now averaging smaller oscillations with larger ones. This increase in the variance introduces the possibility that some seasonality still exists in the data.

Chart 2.8



The Model

A stock/flow modeling approach argues that in the short term, the occupancy and average room rate adjust to equate the hotel room demand to the existing stock of rooms. Alternatively, adjustments, such as new construction or demolition, to the rooms available occur slowly over time and often with a lag. The room supply adjustments respond to the average room rates determined in the market's short run equilibrium.[28]

Using the stock/flow approach for modeling the lodging industry has two distinct advantages over other modeling methods. First, by systematically analyzing the 26 year time series data, the market behavior of the lodging industry can be understood and the driving forces behind demand and supply can be identified and modeled. Second, by processing the historical data through the model, a basis for contingent econometric forecasting is created. This procedure for forecasting will be demonstrated in Chapter 4. A major benefit to contingent forecasting is that different scenarios depicting varying degrees of risk can be analyzed.

As mentioned previously, the entire U.S. national lodging market was observed due to the availability of 25 years of data. Using this data, it has been possible to study methodically the long run trends in hotel construction, the stock of space, room rates and vacancy rates through various economic cycles.

The following section was developed using the econometric modeling techniques presented in William C. Wheaton and Denise DiPasquale's forthcoming textbook, *The Economics of Real Estate Markets*.

Determinants of Demand

Demand in the lodging industry is defined as the number of rooms sold during a given period[29]. Earlier it was stated that the lodging industry adjusts its

[28] Denise DiPasquale and William C. Wheaton, The Economics of Real Estate Markets, (Prentice Hall 1995), p.10-1.

[29] In the case of this study, a period is defined as a quarter of a year

demand on a daily basis. The question is how is this demand determined and adjusted?

Demand for lodging can be measured by the net change in the number of rooms sold (room absorption) between this period and a previous period. A question does arise as to which period comparisons should be made. As explained in Chapter 1, the lodging industry is very cyclical and varies on the weather, season and holidays. Therefore, there is little logical rationale for comparing the number of rooms sold this period with the number of rooms sold last period. For example, January's demand should not be compared with December's considering the number of holidays in December. The statistical comparison would be meaningless. Alternatively, it is logical to compare this period's number of rooms sold, against the number of rooms sold during the same period last year. Comparing this year's January results to last year's January results will yield significant data. The influence of different lag periods on the dependent variables was investigated and the end results are explained below. With this in mind room demand this period ($SOLD_{(t)}$) can be defined as the room absorption (AB) added to the room demand in the same period last year ($SOLD_{(t-4)}$). For this report, the equation can be rearranged to solve for room absorption. This equation is an accounting identity and does not rely on behavioral economics. It can be written as follows:

Equation 2.1

$$SOLD_{(t)}=SOLD_{(t-4)}+AB_{(t)} \quad \textit{or} \quad AB_{(t)}= SOLD_{(t)}- SOLD_{(t-4)}$$

The next step to modeling demand is to determine the potential number of hotel rooms that all hotel guests would demand. This potential demand is a function of exogenous and endogenous variables that influence people's ease and propensity of travel. For this model, three variables: real GDP, enplanements and real average room rate, were presented in the above "Factors Affecting Demand for Hotel Rooms" section.

First the demand for hotel rooms was shown to be positively correlated with the economy (GDP). This relationship was illustrated in Charts 2.1 and 2.2 and represents people's propensity for travel.

The exogenous variable, Enplanements, was presented in Chart 2.7 to be positively correlated with demand and can be used to gauge the ease of travel.

Average room rate was explained to be negatively correlated with demand. Decreasing the room rate was demonstrated as a means to increase the demand for rooms.

Therefore, this potential number of hotel rooms that all hotel guests would demand is an ideal target that is a function of current real Gross Domestic Product ($GDP_{(t)}$), current real average room rates ($R_{(t)}$), and current domestic air passengers ($ENPLANE_{(t)}$) and can be designated by the variable $SOLD^*$.

Equation 2.2

$$SOLD^*_{(t)} = \alpha_0 - \alpha_1 R_{(t)} + \alpha_2 GDP_{(t)} + \alpha_3 ENPLANE_{(t)}$$

The coefficient α_0 determines the baseline number of rooms that would be demanded, while α_1, α_2 and α_3 determine the room demand decrease with average room rate growth and the increase with GDP expansion or domestic air travel increases.

If consumers adjusted their travel levels immediately to changes in room rate, GDP or enplanements, this equation would be an adequate representation of demand. But realistically, consumers do not immediately adjust their travel consumption. For example, as the economy strengthens, some companies may increase their sales trips in order to increase product sales, while other companies adopt a "wait and see" attitude. Consequently, the number of rooms sold adjusts over some time period from its present level ($SOLD_{(t)}$) to the target level ($SOLD^*$). For simplicity, it is assumed that a constant fractional adjustment (τ_1) to rooms sold occurs each period until the target is attained. By rearranging identity Equation 2.1, this adjustment process can be written as so:

Equation 2.3

$$SOLD_{(t)}-SOLD_{(t-4)}=AB_{(t)}=\tau_1[SOLD^*_{(t)}-SOLD_{(t-4)}]$$

As mentioned previously, because of the seasonal fluctuations associated with the lodging industry, better results are achieved if the number of room sold this period is compared to the number of rooms sold in the same period one year ago. In this way we are comparing like periods.

Equation 2.3 says that in each period, a fraction, τ_1, of hotel guests change their amount of travel, from the previous amount to the new desired amount, which in turn alters the number of rooms sold. After some number of periods (depending on the magnitude of τ_1), the actual number of rooms sold ($SOLD_{(t)}$) will equal the target number of rooms sold ($SOLD^*_{(t)}$).

By substituting Equation 2.2 into Equation 2.3, a linear equation is created whereby room absorption and the room demand gradually adjust to a target defined by the Gross Domestic Product, the average room rate and the number of domestic airline passengers.[30]

Equation 2.4

$$AB_{(t)}=\tau_1[\alpha_0-\alpha_1R_{(t)}+\alpha_2GDP_{(t)}+\alpha_3ENPLANE_{(t)}]-\tau_1SOLD_{(t-4)}$$

Equation 2.4 determines how room absorption and room demand adjust to reach the long run target room demand which is a function of the economy, average room rates and domestic air travel. (The term within the brackets is $SOLD^*_{(t)}$ from Equation 2.2). If the demand shock was a one time occurrence and the economy, average room rates and the number of domestic air passengers subsequently remained fixed at a constant level, the number of rooms sold ($SOLD_{(t)}$) would ultimately equal the target rooms sold ($SOLD^*_{(t)}$).

The results of the equation 2.4 regression using the national lodging industry data are presented in Table 2.1.

[30] Denise DiPasquale and William C. Wheaton, The Economics of Real Estate Markets, (Prentice Hall 1995), p.12-9.

Table 2.1

Dependent Variable SOLD (Rooms Sold) - Estimation by Least Squares
Quarterly Data From 1970:01 To 1994:04

Usable Observations	100	Degrees of Freedom	95
Centered R**2	0.987940	R Bar **2	0.987432
Uncentered R**2	0.999452	T x R**2	99.945
Mean of Dependent Variable	1482963.0000		
Std Error of Dependent Variable	325216.7649		
Standard Error of Estimate	36458.6528		
Sum of Squared Residuals	1.26277e+011		
Regression F(4,95)	1945.5860		
Significance Level of F	0.00000000		
Durbin-Watson Statistic	0.516902		
Q(25-0)	114.758337		
Significance Level of Q	0.00000000		

Variable	Coeff	Std Error	T-Stat	Signif
1. Constant	50222.1231	98715.9712	0.50875	0.61210435
2. R	-7880.9657	1683.6077	-4.68100	0.00000947
3. GDP	2.5830e-007	3.6251e-008	7.12524	0.00000000
4. ENPLANE	1.0753e-003	1.3938e-003	0.77148	0.44233912
5. SOLD{4}	0.4105	0.0569	7.21341	0.00000000

By entering the regression results into equation 2.4 and rearranging the terms, Equation 2.5 is created.

Equation 2.5

$$AB_{(t)}=0.5895[85194-13368R_{(t)}+0.000000438GDP_{(t)}+0.0018ENPLANE_{(t)}-SOLD_{(t-4)}]$$

The high R^2 of 0.98794 in Table 2.1 demonstrates that statistically this model is a good fit. The T-Statistic values for all variables except the number of enplanements (ENPLANE) are significant. Actually, excluding enplanements, the significance is to the 99% confidence level.

The insignificant T-statistic on enplanements suggests that the number of rooms sold is not dependent on air travel. Since the aggregate United States was used, which includes hotels, motels and the like, perhaps the automobile would have been a better mode of transportation to investigate.

The significance of the T-statistic on GDP reinforces the theory that lodging demand is primarily driven by the state of the general economy. The significant

T-statistic on last year's number of rooms sold[31] shows that decisions for this period are made based on last years' data for the same period, not last quarters. (The author did investigate this relationship and found yearly comparisons much more robust than quarterly comparisons.)

The above room adjustment model suggests that in each year, the number of rooms sold will move towards the equilibrium room demand at a rate of 0.5895. This means that 58% of the adjustment will occur each year so the target demand will be achieved in 1.72 years.

With regard to the average room rate, the room rate elasticity of demand is calculated at -0.47[32]. This means that for a 1% increase in the real average room rate, the number of rooms sold decreases only by 0.47%. These findings are similar to, but slightly more elastic than, Coopers & Lybrand's price elasticity of demand of -0.39.

The signs on the coefficients are all as expected. The real average rate is negatively correlated with the number of rooms sold while the Gross Domestic Product, the number of enplanements and the number of rooms sold in the same period last year are positively correlated.

The total room absorption is now entered into Equation 2.1 and added to the demand for the same period last year to determine a new total room demand ($SOLD_{(t)}$).

The next step to modeling demand is to determining the corresponding average room rate equation. To do this, a second identity equation must be presented. This equation defines the occupancy rate as a ratio of room demand ($SOLD_{(t)}$) to room supply ($S_{(t)}$) in any period.

Equation 2.6

$$OC_{(t)}=SOLD_{(t))}/S_{(t)}$$

[31] {4} represents a four period lag in the data.

[32] (13368*51.50)/(1462665.38.585) -For all elasticities, the mean value for the 26 year data series were used for calculations.

If the room supply is taken as given, the room demand will yield a stable occupancy rate (OC) for each value of average room rate (R), GDP, and enplanements (ENPLANE). Since the number of rooms sold has been solved for in Equation 2.5, it can be entered into identity Equation 2.6 and the occupancy rate can be solved for.

Previously, it was argued that the change in the real average room rate is positively correlated with the occupancy rate (Chart 2.4). This means that if occupancy increases due to demand, a higher room rate can be charged. Alternatively, if occupancy begins to fall, the hotel operator reduces room rates in an effort to halt the downward trend.

Inflation's peculiar influence on the real average room rate was also presented (Chart 2.5). Historically, room rate inflation has been affected by inflation but has been tempered by occupancy. In the forthcoming regression it will be shown that inflation's overall effect on the real average room rate is negative. This means that inflation inhibits the raising of room rates by hotel operators.

The next phase of modeling demand is to determine the equilibrium average room rate that all hotel operators would be willing to accept. This room rate is an ideal target that is a function of last year's occupancy rate ($OC_{(t-4)}$) and inflation rate($INF_{(t-4)}$) and can be designated by the variable R^*.

Equation 2.7

$$R^*_{(t)}=\mu_0+\mu_1 OC_{(t-4)}-\mu_2 INF_{(t-4)}$$

The coefficient μ_0 determines the baseline average room rate that would be charged, while μ_1 and μ_2 determine the room rate increase with occupancy rate growth and the decrease associated with inflation.

If hotel operators adjusted the room rate immediately to changes in the occupancy rate and inflation, Equation 2.7 would suffice in determining the real average room rate. But realistically, hotel operators do not immediately adjust their room rate. A hotel operator may raise or lower the room rate with an occupancy rate shock or wait to see if the shock will continue. An operator may also opt to adjust only partially their room rates. Regardless, the average room rate adjusts over some time period from its present level ($R_{(t)}$) to the target level (R^*) for this is the rate hotel operators want to be at. For simplicity, it is assumed that a constant fractional adjustment (τ_2) to the real average room rate occurs each period until the target is attained. By again utilizing the format of identity Equation 2.1, this room rate adjustment process can be written as so:

Equation 2.8

$$R_{(t)}-R_{(t-4)}=\Delta R_{(t)}= \tau_2[R^*_{(t)}-R_{(t-4)}]$$

As mentioned previously, because of the seasonal fluctuations associated with the lodging industry, better results are achieved if the real average room rate of this period is compared to the real average room rate in the same period one year ago. In this way we are comparing like periods.

Equation 2.8 says that in each period a fraction, τ_2, of hotel operators adjust their real average room rate from the previous level to the new desired level which in turn alters the average room rate. After some number of periods (depending on the magnitude of τ_2), the actual real average room rate ($R_{(t)}$) will equal the target average room rate ($R^*_{(t)}$).

By substituting Equation 2.7 into Equation 2.8, a linear equation (2.9) is created whereby the average room rate change and the average room rate gradually settle at an equilibrium defined by the occupancy rate ($OC_{(t-4)}$)and inflation rate ($INF_{(t-4)}$)[33].

Equation 2.9

$$R_{(t)}-R_{(t-4)}=\tau_2[\mu_0+\mu_1 OC_{(t-4)}-\mu_2 INF_{(t-4)}]-\tau_2 R_{(t-4)}$$

Equation 2.9 determines how the change in the real average room rates and the real average room rates adjust to reach the long run ideal average room rate which is a function of the occupancy rate and inflation. (The term within the brackets is $R^*_{(t)}$ from Equation 2.7).

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[33] Denise DiPasquale and William C. Wheaton, The Economics of Real Estate Markets, (Prentice Hall 1995), p.12-9.

The results of the Equation 2.9 regression using the national lodging industry data are presented in Table 2.2.

Table 2.2

Dependent Variable R (Real Average Rate) - Estimation by Least Squares
Quarterly Data From 1970:01 To 1994:04

Usable Observations	100	Degrees of Freedom	96
Centered R**2	0.961116	R Bar **2	0.959901
Uncentered R**2	0.999471	T x R**2	99.947
Mean of Dependent Variable	51.864960145		
Std Error of Dependent Variable	6.124128870		
Standard Error of Estimate	1.226345987		
Sum of Squared Residuals	144.37675016		
Regression F(3,96)	790.9559		
Significance Level of F	0.00000000		
Durbin-Watson Statistic	0.346323		
Q(25-0)	303.845287		
Significance Level of Q	0.00000000		

Variable	Coeff	Std Error	T-Stat	Signif
1. Constant	-4.36022016	2.21630235	-1.96734	0.05203030
2. OC{4}	15.54706588	3.71891849	4.18053	0.00006422
3. INF{4}	-11.88148271	4.76004036	-2.49609	0.01426194
4. R{4}	0.91690513	0.02204094	41.60009	0.00000000

By entering the regression results into equation 2.4 and rearranging the terms, Equation 2.10 is created.

Equation 2.10

$$\Delta R_{(t)}=0.083[-52.53+187.314OC_{(t-4)}-143.15INF_{(t-4)}-R_{(t-4)}]$$

The high R^2 of 0.96 in Table 2.2 demonstrates that statistically this model is a good fit. The T-Statistic values for all variables are significant. In fact, all variables are significant to a confidence level of 98%. The average room rate adjustment model suggests that in each period, the average room rate moves toward the target average room rate at a rate of .083. This is a very slow adjustment and can be interpreted thus. All else equal, it will take over 12 years for the real average room rate to adjust to the target room rate.

The slowness of this price adjustment shows that hotel operators do not believe that rate changes are the answer to filling a hotel and are reluctant to alter them. This reinforces the price elasticity of demand calculation of 0.47 calculated from Table 2.1.

Therefore, there must be a reason that hotel operators do not dramatically change rates to attract customers. The hotel operator must believe that there is some hidden value for keeping a rate high and a room unoccupied.

One argument is that the vacant room has an option value. An option value is the value associated with not renting a room now with the hope of renting it for a higher price in the future. The slow adjustment process demonstrates that the hotel operators value this component highly. The factors underlying the option value are difficult to identify and are probably a combination of many random variables. They may include predictions based on tourism projections, hotel property reputation, the fear of starting a room rate war with the competition, corporate policy limitations, fixed and variable expenses, etc. Regardless of the option value's components, its influence on the operators makes them reluctant to dramatically alter their room rates.

The room rate elasticity with regard to occupancy is 2.3[34]. This means that for a 1% increase in occupancy the price increases by 2.3%. Using historic average values for the United States lodging industry, the equation implies that the real average room rate will head towards $58.34[35] in 1990 dollars.

The signs on the coefficients can be explained as thus. The occupancy rate from last year is positively correlated with the average rate. If the occupancy is increasing, the room rate can also be increased. The significance of the T-statistic on last year's real average rate for the same period reiterates that the industry is making its decisions based on last year's period data and not last quarter's.

As discussed, inflation is negatively correlated with the real average room rate. As inflation increases, the real room rate's value decreases.

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[34] (187.314*0.63)/51.50

[35] (-52.53+(187.314*0.63)-(143.15*0.0559))

Summary

The model to this point demonstrates how the average room rate determines the room absorption, how the room absorption determines occupancy rates and how occupancy rates determine the average room rate. The combination of Equations 2.1 to 2.9 has created a demand model for the lodging industry that works as follows: [36]

First, given an average room rate, real GDP and the number of domestic air passengers, Equations 2.4 eventually yields a stable (zero absorption) number of rooms sold via identity Equation 2.1. Identity Equation 2.6 takes this stable number of rooms sold and yields a stable occupancy rate. Equation 2.9 takes this occupancy rate and adjusts room rates until they are stable. When the room rates and the occupancy rate are the same in Equation 2.9 as they are in Equation 2.8, then the market is at equilibrium. In this equilibrium, the average rate yields travelers to demand a number of hotel rooms that yields an occupancy rate, which in turn leads to the same stable value of room rates.

Second, if travel increases, the change in the number of rooms sold turns positive, and with the given stock of hotel rooms, occupancy increases (Equations 2.4 and 2.6). The increase in occupancy causes room rates to increase (Equation 2.9). As the room rate rises, room absorption decreases. Eventually, a new, stable equilibrium is reached with a higher level of room rates, no change in the number of rooms sold and a higher occupancy rate.

Third, if the stock of guest rooms increases, occupancy rates fall and this causes the real room rates to fall (Equations 2.4 and 2.6). Falling room rates cause an increase in the number of rooms sold (Equation 2.9), which in turn, increases the occupancy rate. Eventually, a new stable equilibrium is reached where the real average room rates are lower, the room absorption remains constant, and the occupancy rate is lower.

[36] Denise DiPasquale and William C. Wheaton, The Economics of Real Estate Markets, (Prentice Hall 1995), p.12-15.

Quantitatively, for the room sold adjustment model, the real average rate was shown to be negatively correlated with room absorption while GDP and enplanements were shown to be positive. The room sold adjustment model was determined to adjust slowly towards the target demand at a rate of 58% per year. Additionally, the room rate elasticity of demand was found to be only -0.47 which demonstrates that the quantity demanded is not sensitive to changes in the real average room rate.

For the real average rate model, the occupancy rate was shown to be positively correlated with the change in real average room rates while inflation was shown to be negatively correlated. The rate adjustment factor was calculated at 8.3%, which is very slow. The occupancy elasticity with respect to price was shown to be 2.3 which demonstrates that price is sensitive to changes in the occupancy rate.

This model also suggests that any shocks to the real Gross Domestic Product will also cause a very slow change to the real average room rate.

These elasticities suggest that for changes in the real Gross Domestic Product, the room absorption and real average room rate adjusts slowly.

CHAPTER 3

Supply

This chapter is devoted to the subject of supply for the U.S. lodging industry. In the first section, the 26 year time series data is presented and the determinants of supply are identified. Interaction between endogenous and exogenous variables is examined as is the interrelationship between endogenous variables. With this information, an econometric model for supply is subsequently developed. The time series is then processed and the chapter concludes with an analysis of the results.

Factors affecting the supply of hotel rooms

As was demand, national hotel room supply is also a function of many different variables. The most prominent effects come from financial and governmental influences but other factors such as obsolescence, economic, geographic, environmental and technological must also be considered. The issue at hand is whether it is possible to develop an econometric model that will accurately forecast supply as these variables change.

Financial and Governmental

Hotels are expensive forms of real estate to develop. Consequently, hotel development is highly dependent on the availability of capital. Ignoring the straight loan which has been in existence for eons, various alternative methods of financing have been created in the last forty years to make lodging financing readily available.

In 1946, both the Sheraton and Hilton hotel companies listed on the New York Stock Exchange[37]. These were the first ventures into the public equity market for the lodging industry. This method demonstrated that the stock market was a

[37] Stephen Rushmore, *Hotel Investments, A Guide for Lenders and Owners*, (Warren, Gorham & Lamont. Boston and New York 1990), p.2-17.

viable choice for financing lodging expansion development. This financing method has proliferated since the mid-1960's and publicly traded hotel corporations are listed worldwide on most major exchanges.

In the 1950's, accelerated depreciation combined with interest deductions created the syndication deal[38]. The high depreciation and interest charges associated with hotel properties could be used to offset income and thus reduce taxes. For that reason, a large amount of hotel development was now being financed with "tax-driven" deals. The syndication deal, for the most part, ended with the advent of the 1986 Tax Reform Act which seriously curtailed the aforementioned benefits.

In the latter half of the 1980's, the deregulation of the Savings & Loan Banks made borrowing very easy. With deregulation, lending for high risk real estate developments increased dramatically. The number of banks increased due to a relaxing of the industry's barriers to entry. Background checks on lenders were eased. Minimum balances of deposits in banks were relaxed. Government scrutiny was minimal.

Additionally, banks were also trying to stem the disintermediation of funds into vehicles such as mutual funds. Commercial banks started to compete with the Savings & Loan banks on lending to hotel projects. Altogether, banks were lending funds at almost unprecedented terms.

This financing fervor led to banks making loans on real estate projects without understanding the associated risks. Many real estate projects were built with no feasibility studies or due diligence. Loan to Value Ratios exceeded 80% and could sometimes reach 100%. Hotel developers and investors reaped these benefits as did developers and investors in other real estate sectors. In actuality, from 1984 to 1989, bank loans in all categories increased by $512 billion. Of this amount, real estate accounted for $367 billion or 72% of the increase[39].

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[38] Stephen Rushmore, *Hotel Investments, A Guide for Lenders and Owners*, (Warren, Gorham & Lamont. Boston and New York 1990), p.2-17.

[39] David E. Arnold and L. Clark Blynn, "Industry Insights: Welcome to the Better Part of the 1990's", *Trends In the Hotel Industry*, (Pannell Kerr Forster, 1881), p. 3

This lending continued until the late 1980's when loans began to default in record numbers. The collateral securing the loan was insufficient to recoup the loan money which led to the draining of banks' assets. The Savings & Loan banks' asset/liability matching problem grew geometrically which led the banks to recall other outstanding loans. This, in turn, caused more hotel development loan defaults. The compounding of real estate debt led to the failure of many Savings & Loan banks. This collapse curtailed real estate lending which ultimately resulted in a temporary cessation in hotel development. It is only recently that banks have begun to warily lend for hotel development.

In the 1970's and again in the mid-1990's, the REIT (Real Estate Investment Trust) structure was able to attract large amounts of investment which was to be utilized in part for hotel development. The REIT structure allows for ownership of real estate assets in the form of shares. The major benefit of the REIT structure is the avoidance of taxation at the corporate level.

At the end of 1994, there were six public hotel REITs consisting of one hundred and six properties having an equity capitalization of $721 million. Also at this time, there were seven companies in registration for REITs consisting of two hundred and thirty-six properties with an equity capitalization of $1.2 billion. [40]

Since this period, the hotel REIT market has been on an unofficial hiatus while complications in the REIT structure are reanalyzed. The hotel REIT is more complicated than the REITs of other types of real estate due to conflict of interest issues. Under REIT laws, hotel income is considered unqualified, hence the REIT could be taxed on this income. To qualify for the REIT status, a complex lease structure has evolved whereby the REIT leases the hotel to a management company pursuant to a participating lease. Lease payments are then made based on gross revenues. The conflict that has arisen concerns the lessee being affiliated or unaffiliated with the REIT.

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[40] Jonathan Litt, "Hotel REITs- Under Siege?", Salomon Brothers Equity Real Estate Securities, November 8, 1994, p.3

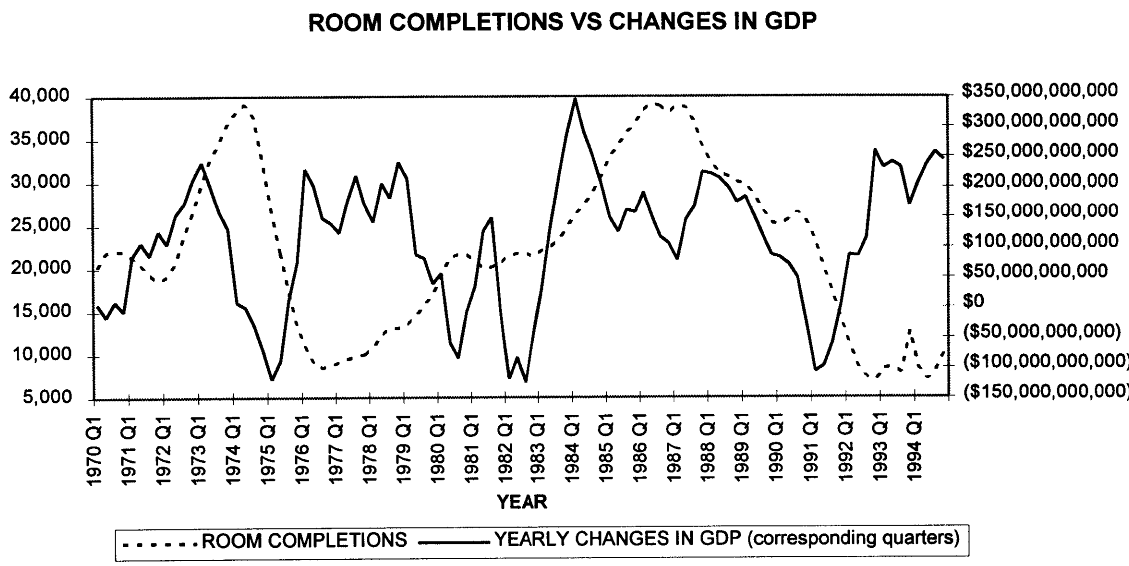
Another popular financing method of the early 1980's was the Master Limited Partnership. Master Limited Partnerships are extended partnerships that cover a broad base of the company's assets as opposed to just one property. The Master Limited Partnerships were usually publicly traded which allowed for a large ownership base while still allowing for control by the management company (usually the general partner). Before the 1986 tax changes, these partnerships were free of corporate income taxes and dividends were paid out of pretax income. Since, the 1986 tax change, the popularity of this financing method has diminished.

Another trend in the late 1980's and early 1990's was the purchase of hotels by foreign entities. These properties were usually "trophy" properties in the deluxe category. This trend was compounded by the weak U.S. dollar on the foreign exchange. This influx of capital was in turn used to fund new development.

Because the majority of hotel properties are built with financing, the ability to arrange affordable financing, regardless of the source, is essential to development. In reality, this ability to arrange financing may outweigh demand as the driving force behind development. In Chart 3.1, it is evident that development tends to synchronize real GDP with a one and a half year lag. In recessing economies, where financing is more difficult, development tends to decrease. Alternatively, in expanding economies, development increases due to the availability of financing. The recessions of the mid-1970's and early 1990's are clearly mimicked by a decrease in development while the peaks of the early 1970's and mid-1980's are marked by a corresponding increase.

There are a few periods when this correlation does seem contradicted. From 1977-1979, the GDP was high but completions plummeted. This was probably due to the extreme overbuilding in the lodging market in the early 1970's. In 1981 and 1982, completions were at a moderate level while GDP was decreasing. Interest rates were at a historical high at this time decreasing the GDP. Alternatively, hotel occupancies and room rates were high spurring development. The two opposing forces resulted in a period of short term moderate room completions. In 1993 and 1994 the GDP was increasing yet room completions were minimal. This is probably related to the difficulty of financing hotel projects in the early 1990's. Because of all the defaulted loans from the late 1980's and early 1990's, banks were reluctant to lend money for lodging projects.

Chart 3.1



Interest rates, though related to the state of the economy, should be investigated separately. When interest rates are low, financing is more available for development because of higher returns. When interest rates are high, the spread between hotel development returns and treasury note returns are decreased and financing is more difficult. Chart 3.2 illustrates the negative correlation that exists between interest rate levels (10 year Treasury Note rates[41] are used as a proxy throughout this study) and changes in supply. In the late 1970's and early 1980's, when interest rates were very high, development was minimal. Alternatively in the mid 1980's, when interest rates were very low, development increased dramatically.

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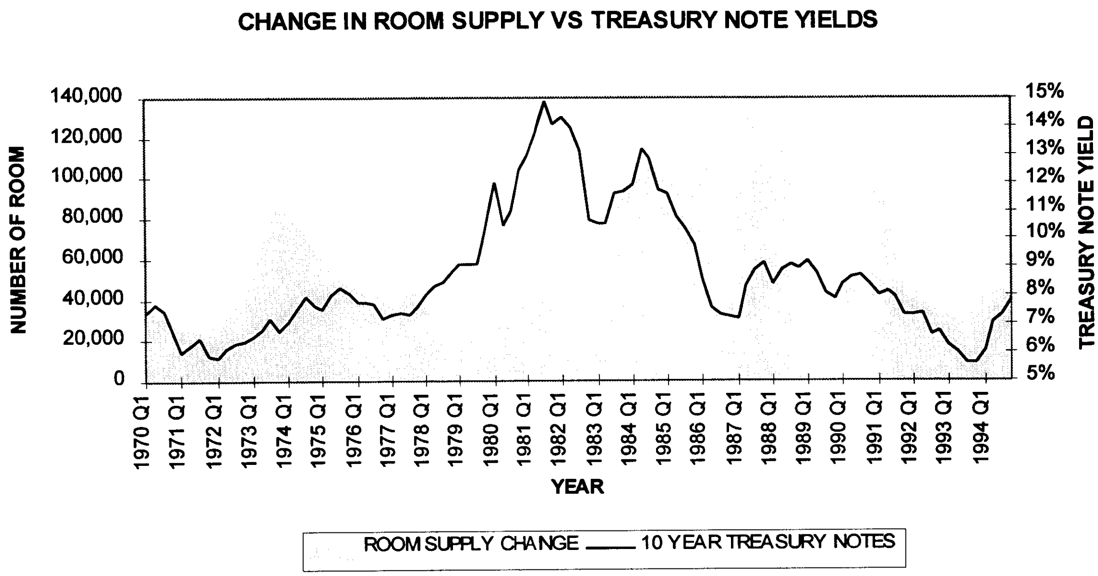
[41] This rate is as listed in the *Annual Statistical Digest* published by the Board of Governors of the Federal Reserve System.

Chart 3.2

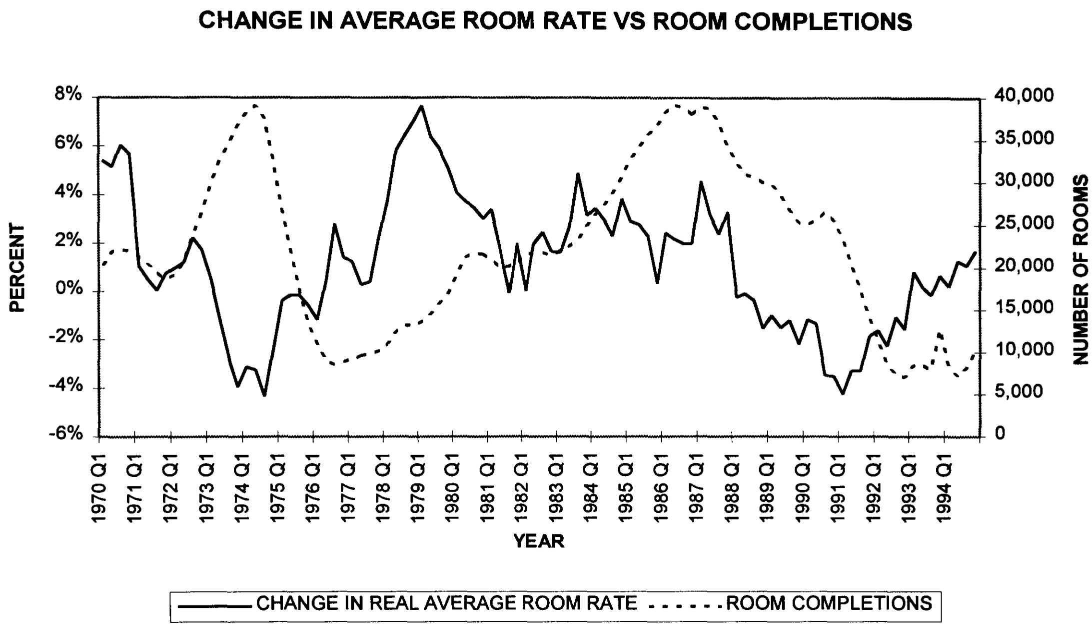


This finance driven development, versus demand driven development, has had many historical, negative implications on the lodging industry.

Referring to the lodging industry real estate cycle description in Chapter 1, increased development with a constant demand automatically reduces the occupancy rate. Later it was shown that a decrease in occupancy is matched by a corresponding room rate drop. Therefore, room completions should move inverse with the average room rate.

The positive relationship between room completions and the change in the average rate is illustrated in Chart 3.3 as having a two year lag. Using the last economic cycle as an example, the ease of financing properties from 1983 to 1988 gave rise to excessive lodging development. Without the corresponding demand increase, room rates declined in real terms by almost 10% and achieved a low in early 1991. It was not until the end of 1992 that development came to a virtual standstill, that demand was able to exceed supply and room rates began to rise.

Chart 3.3

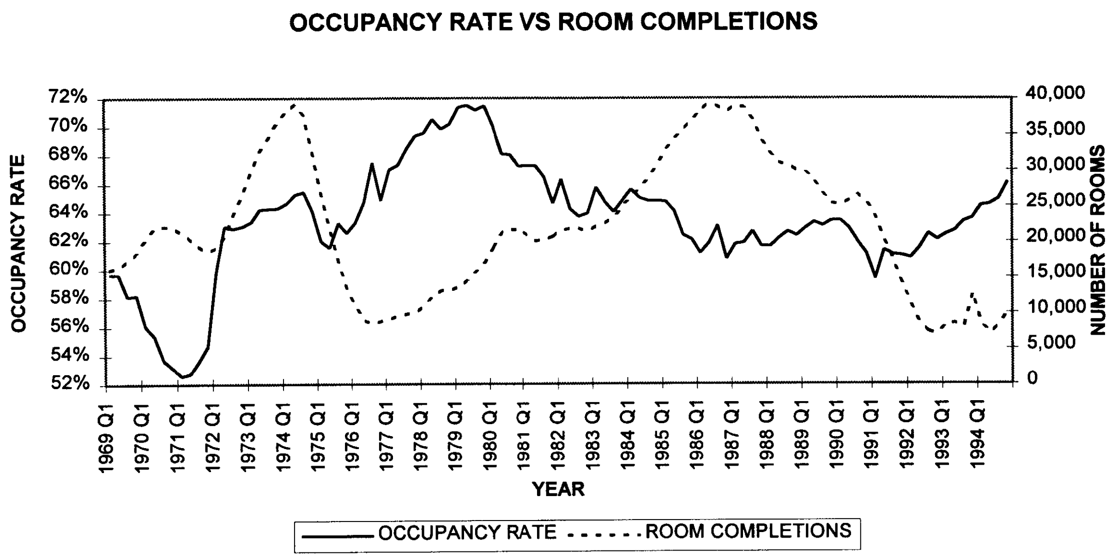


In Chapter 2 the interdependence of room rate and occupancy were discussed. Again, if demand is held constant, occupancy rates will fall with increased supply because the guest has more property substitutes to choose from.

Referring to Chart 3.4, the highest occupancies can be observed in 1970 at 72%. At this time, the prime rate was at a record high which made financing new projects unfeasible. Therefore, as demand increased with less available supply, occupancy rose.

This trend due to high interest rates was again repeated in the early 1980's. These interest rates made financing expensive which decreased development. With little new supply, demand absorbed the vacant space and increased occupancy. The deregulation of financing in 1983 caused a development glut which subsequently led to a steady decline in the occupancy. The tax reform law of 1988, made financing difficult again and development virtually ceased. Due to the inherent lag associated with development, new supply continued to enter the market for approximately one and a half years more. This additional supply further decreased the occupancy rate to a low of 56% in 1990/1991. After 1991, demand finally exceeded supply and occupancy rates began to rise.

Chart 3.4



Obsolescence

For the hotel investor, the economic life of a hotel property is a major factor when considering development. As the hotel stock ages, it can become obsolete both functionally and aesthetically.

Functional obsolescence is related to changing public opinion as to acceptable accommodations. For example, in many deluxe hotels, the availability of a first rate health club has become standard. Hotels lacking this facility may have a difficult time competing in the market. Usually, functional deficiencies can be corrected, but this correction may prove to be prohibitively expensive.

Aesthetically, older hotels require more money to maintain their competitiveness. Renovations of public spaces and guest rooms are periodically required. Again, these renovations and maintenance fees may become prohibitively expensive.

Compared to other forms of real estate such as office buildings or shopping centers, hotels are expensive properties to operate. For hotels, the maintenance costs, product marketing and guest services can equal 80% of gross sales. These high expenses leave only a small margin for debt service and profit.

Ultimately, for some hotels, there comes a time when the expenses outweigh the revenue from the property and any renovations that could be made, would be impossible to recover with the potential cash flows. At this point the logical course of business is either to demolish or abandon the structure. For this thesis, this action will be referred to as scrappage.

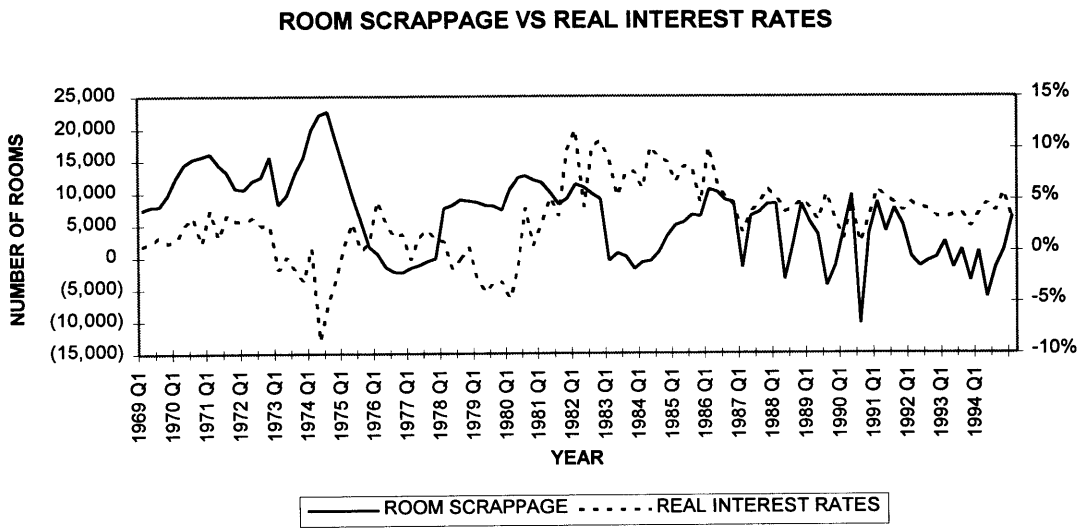
Chart 3.5 shows that historically, there is a negative correlation between room scrappage[42] and real interest rates[43]. If real interest rates are low, properties and cash flows have a higher value due to discounting. With a poorly performing property this is a more difficult goal to meet, hence scrappage increases. If real interest rates are low, the value of the property is easier to attain thus scrappage becomes unwarranted.

Additionally at times of low real interest rates, renovations are more costly, and the potential for recovering these increased costs through the room revenue diminishes.

[42] This identity was calculated based on data provided by F.W. Dodge via Coopers & Lybrand.

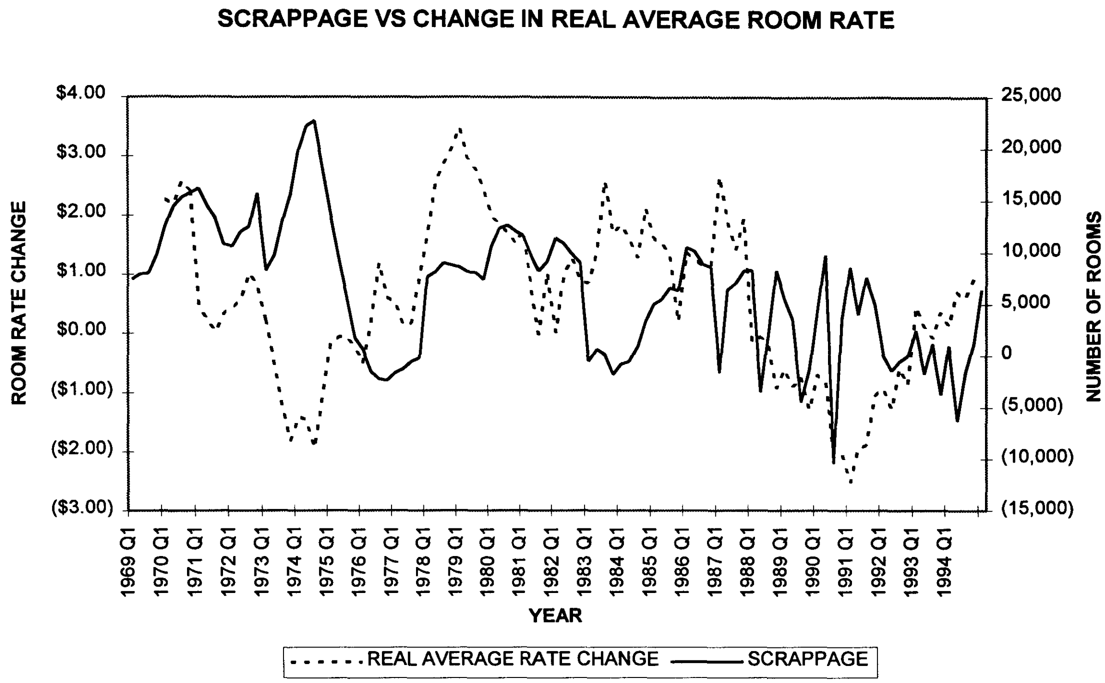
[43] Real interest rates are defined as the difference between the 10 year Treasury Note rate and the inflation rate.

Chart 3.5



A related variable to real interest rates would be the level of real average room rates. If real average room rates are high or increasing, probably due to low inflation, the revenue or ability to earn revenue increases. This additional revenue increases the likelihood that a hotel is profitable and the potential for renovation expense recovery increases. Alternatively, if real average room rates are decreasing the likelihood of covering expenses and recovering a capital improvement expense decreases and makes scrappage a more attractive alternative. (Chart 3.6)

Chart 3.6



It is important to note that true hotel room scrappage has never truly been monitored. Historically, it was calculated endogenously by taking the room stock this year and subtracting last year's room stock and this period's room completions. Both the room stock and room completions are reported as historical data. Regardless, in many years, room scrappage was calculated as a negative number. This is impossible and must be credited to some error in the data. The error could be attributable to the following inconsistencies.

First, R. S. Means company reports data on square footage of room starts in each period. Their information is based on extensive surveys. From this data, relative completion dates are calculated through an algorithm. An error could arise with calculating the completion times of projects. Some projects may be delayed while others are completed ahead of schedule. The R. S. Means data may miss these discrepancies.

With regard to the room stock, this data was based on survey information from Smith Travel Research. It is possible that some properties were missed in the survey thus skewing the total room stock data. Furthermore, new room stock due to completions or missing room stock due to scrappage may be missed in a period and reported in a subsequent period. This reporting error would also skew the data.

Despite the errors, the negative numbers for room scrappage were used to determine all stochastic equations.

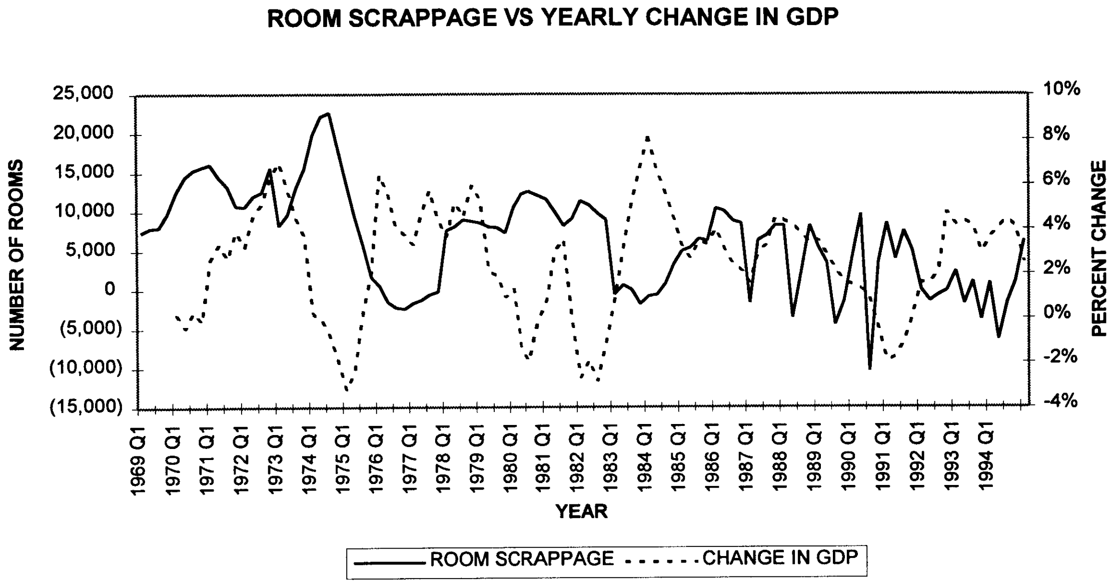
Economic

As stated in Chapter 2, the economy (Gross Domestic Product) is the driving force behind people's propensity to travel and the two are positively correlated. Therefore, it is logical to assume that scrappage and the economy are negatively correlated. If the economy is in recession, fewer people are traveling, properties are earning less revenue and scrappage becomes more attractive. Alternatively, in expanding economies, the scrappage alternative becomes less attractive because more people are traveling and hotels have a greater potential to earn revenue.

Historically, Chart 3.7 shows that the scrappage and the change in real GDP were negatively correlated until the late 1980's and again after 1992. The fluctuations in the scrappage in the late 1980's and early 1990's are probably due to the 1987 tax law change and Savings & Loan bank crisis. With the massive number of foreclosures, hotels were periodically auctioned off creating by the RTC[44]. This timing influenced the new defaulted portfolio owner's ability to assess their new property holdings and exercise their scrappage option.

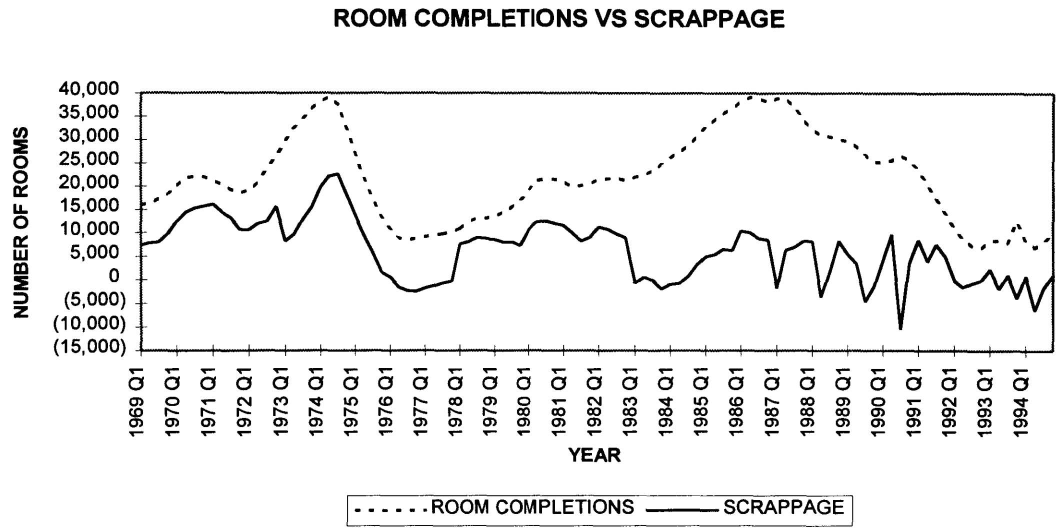
[44] Resolution Trust Corporation

Chart 3.7



From Chart 3.8, it is apparent that scrappage and room completions are positively correlated. This is logical for as new stock enters the market, the older stock has problems competing. Additionally, some owners may decide that demolishing their existing property and building a new hotel may be more profitable. With demand constant, the guest prefers a newer property rather than an older property. Thus, it makes it more difficult for older properties to compete in the marketplace and the scrappage option gains merit. Room completions and scrappage seem highly correlated until 1983 and again after 1992. For the nine years in between, the correlation seems nonexistent. This is probably due to the tax act of 1983 and booming economy. In 1988, the new tax law changed the whole development market bringing new development to a halt.

Chart 3.8



Environmental

Increasing environmental regulations make constructing and operating hotels more expensive. Items such as the installation of waste water treatment plants, non-CFC air-conditioning, surcharges on public utilities during peak hours make hotel development and operation more expensive than other forms of real estate. Additionally, new regulations increase the chance that existing hotels are forced into expensive retrofit projects in order to comply.

Technological

Technology's implication on construction should be briefly addressed. A major determiner of real estate market cyclicality is the lag between room starts[45] and room completions[46]. It is this lag that over-emphasizes the amplitude of the cycle. As construction technology improves, the lag decreases and the

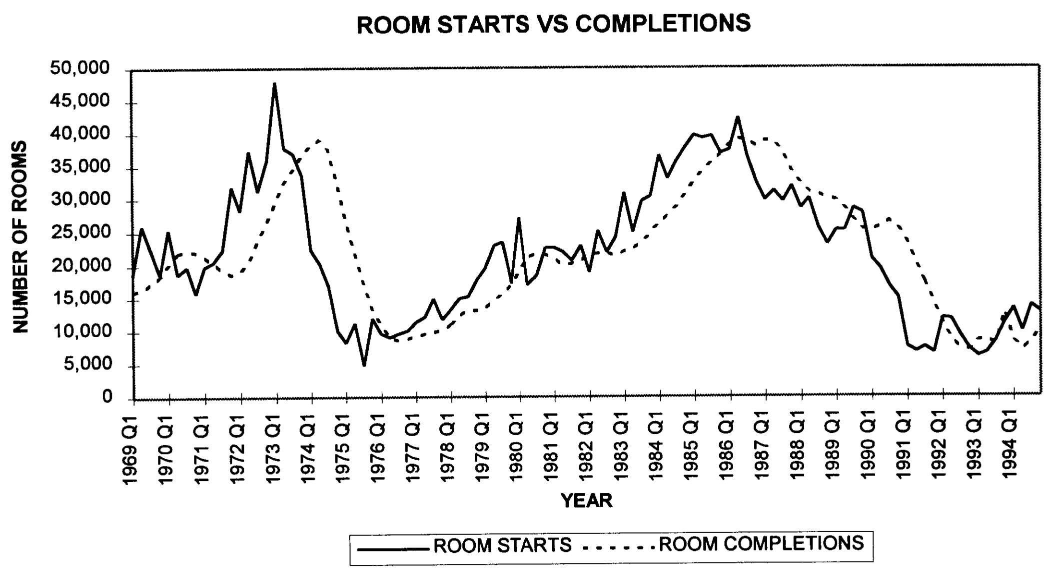
[45] Room Starts is defined as the number of hotel guest rooms began each period. This information was provided by Coopers & Lybrand. Coopers & Lybrand receives this information from F.W. Dodge (a division of McGraw Hill) and converts the square footage reporting into a guest room count.

[46] Room Completions is defined as the number of hotel guest rooms completed in each period. This information was provided by Coopers & Lybrand. Coopers & Lybrand receives this information from F.W. Dodge (a division of McGraw Hill) and converts the square footage reporting into a guest room count.

frequency between cycles decreases, theoretically resulting in a quicker steady state.

The present one and a half year construction lag time, as shown in Chart 3.9, also means that different market conditions may exist at the beginning of construction as do at the end of construction. The longer the lag between start and completion, the higher the volatility and greater the risk of market fluctuation. It is important to emphasize that once the development option is exercised, it is near impossible and very expensive to halt. As the lag time decreases due to technological advancement, the risk associated with construction will decrease.

Chart 3.9



The Model

As stated in Chapter 2, a stock/flow modeling approach argues that in the short term, the occupancy and average room rate adjust to equate the hotel room demand to the existing stock of rooms. Alternatively, adjustments, such as new construction or demolition, to the rooms available occur slowly over time and often with a lag. The room supply adjustments respond to the average room rates determined in the market's short run equilibrium.[47]

[47] Denise DiPasquale and William C. Wheaton, The Economics of Real Estate Markets, (Prentice Hall 1995), p.10-1.

The following section was developed using the econometric modeling techniques presented in William C. Wheaton and Denise DiPasquale's forthcoming textbook, *The Economics of Real Estate Markets.*

Determinants of Supply

Supply (room stock) in the lodging industry is defined as the number of rooms available during a given period[48]. Previously, it was stated that the lodging industry adjusts supply slowly and with a lag. The question is how is this supply determined and adjusted?

Lodging supply this period ($S_{(t)}$) can be defined as the stock of rooms in the previous period ($S_{(t-1)}$), plus this period's completions ($C_{(t)}$), minus this period's scrappage ($SCRAP_{(t)}$). This equation is an accounting identity and does not rely on behavioral economics. It can be written as follows:

Equation 3.1

$$S_{(t)}=S_{(t-1)}+C_{(t)}-SCRAP_{(t)}$$

To continue the supply side modeling, the number of room completions and scrappage must therefore be determined.

As was done in the demand side equations, it can be assumed that there is number of new completions that all developers would like to bring to the market that is a function of certain endogenous and exogenous variables.

Furthermore, as shown in Chart 3.9, the lag between room starts and completions is approximately one and a half years. This means that market oriented decisions are being made 1 to 2 years before any new stock is actually added to supply.

To begin the development process, a developer first needs to analyze the amount of current stock and the amount of stock coming on line from other developers. With this total stock estimate combined with the conclusions from Chapter 2 that absorption and real average rates adjust slowly, an assessment

[48] In the case of this study, a period is defined as a quarter of a year

of the future market can be made. If the market is favorable, financing of the potential project must then be considered to determine feasibility.

To model construction (room completions), five variables were identified as having significant influence over room completions. They are the existing total room stock, the real average rate, interest rates, room rate inflation, and room absorption.

First, the endogenous variable of available rooms (S) should be negatively correlated with construction. As was shown, occupancy tends to lead room completions with a lag. If occupancy is decreasing due to an increasing room stock, room completions will follow this trend after a lag. Logically, the larger the room stock, the less new rooms that are needed.

As was described in Chapter 1, properties are valued from cash flows which are primarily determined by real average room rates (R). If room rates are high, then the potential that the new project will make money improves.

Moreover, not only should room rates be considered but also their future trends. With the time lag of construction, the trend of real average room rates (R%DIFF) must also be considered. For example, forecasting a high average room rate in two years and ignoring the fact that it will plummet in the third year could lead to a costly mistake. An upward trending room rate should lead to increased construction. As was shown in Chart 3.4, the change in real average room rates and room completions is positive.

The room absorption (AB) of all vacant room stock must be considered. This includes present, vacant room stock, the planned new completions by other developers and the proposed project. If absorption is increasing, then there is a greater chance that the new room stock will be occupied. If room absorption is decreasing, then there is a diminishing chance that new room stock will be occupied. Therefore, a positive correlation between the changes in room absorption and room completions can be expected.

Finally, interest rates (TNOTES) must be considered when planning any development. As discussed in the "Financial" influences section above, if interest rates are low, the returns on hotel projects are more attractive and financing is readily available. Alternatively, if interest rates are high, the returns required from a lodging project is more difficult to justify and credit availability diminishes. This leads to a fall in construction rates. Therefore, a negative correlation as shown in Chart 3.2, is expected between room completions and interest rates[49].

Collectively, the potential number of room completions becomes an ideal target that is a function of the existing room stock, the real average room rate, the trend of the real average room rate, interest rates, and room absorption; and can be designated by the variable C^*.

Equation 3.2

$$C^*_{(t)}=\beta_0-\beta_1 S_{(t-4)}+\beta_2 R_{(t-8)}-\beta_3 TNOTES_{(t-4)}+\beta_4 R\%DIFF_{(t-4)}+\beta_5 AB_{(t-4)}$$

The coefficient β_0 determines the baseline number of rooms that would be constructed. β_1, β_2, β_3, β_4 and β_5 determine the room completions increase with respects to average rate, average rate inflation, and absorption growth and the completions decrease with respect to increases in the room stock and interest rates.

The variables are lagged based on when the developer considers the market influences in his decision process[50]. It is interesting to note that real interest rates have a two year lag as shown in Chart 3.3.

As was done for the demand side model, construction is determined as an adjustment model. If developers could adjust their construction levels immediately to changes in demand or interest rates this equation would be an adequate representation of construction. But realistically, developers do not immediately adjust their construction level. For example, as real average room rates increase, developers do not immediately adjust their construction level.

[49] 10 year treasury notes are used as a proxy for interest rates.

[50] These lags were chosen for they produced the highest R^2 with coefficients of the correct signs.

Some may start to build more while others adopt a "wait and see" attitude to see if the trend continues.

Consequently, the number of rooms completed adjusts over some time period from its present level ($C_{(t)}$) to the target level (C^*). For simplicity, it is assumed that a constant fractional adjustment (τ_3) to room completions occurs each period until the target is attained. By again using identity Equation 2.1, this adjustment process can be written as so:

Equation 3.3

$$C_{(t)}-C_{(t-4)}=\Delta C_{(t)}= \tau_3[C^*_{(t)}- C_{(t-4)}]$$

As mentioned previously, because of the seasonal fluctuations associated with the lodging industry, better results are achieved if the number of room sold this period is compared to the number of rooms sold in the same period one year ago. In this way we are comparing like periods.

Equation 3.3 says that in each period, a fraction, τ_3, of developers change their amount of construction (room completions), from the previous amount to the new desired amount. This, in turn, alters the number of rooms completed. After some number of periods (depending on the magnitude of τ_3), the actual number of rooms completed ($C_{(t)}$) will equal the target number of rooms completed ($C^*_{(t)}$).

By substituting Equation 3.2 into Equation 3.3, a linear equation is created whereby the change in room completions and room completions gradually adjust to a target defined by the total room stock, the real average rate, interest rates, room rate inflation and room absorption.[51]

Equation 3.4

$$C_{(t)}-C_{(t-4)}=\tau_3[\beta_0-\beta_1 S_{(t-4)}+\beta_2 R_{(t-8)}-\beta_3 TNOTES_{(t-4)} +\beta_4 R\%DIFF_{(t-4)}+AB_{(t-4)}]-\tau_3 C_{(t-4)}$$

Equation 3.4 determines how the change in room completions and room completions adjust to reach the long run target completions which is a function of the total room stock, the real average rate, interest rates, room rate inflation and

[51] Denise DiPasquale and William C. Wheaton, The Economics of Real Estate Markets, (Prentice Hall 1995), p.12-9.

room absorption. (The term within the brackets is $C^*_{(t)}$ from Equation 3.2). If the shock to construction was a one time occurrence such as an increase in demand (AB increases) and the room stock, average room rate, interest rates, and room rate inflation remained fixed at a constant level, the number of rooms completed ($C_{(t)}$) would ultimately equal the target number of rooms completed ($C^*_{(t)}$).

The results of the Equation 3.3 regression using the national lodging industry data are presented in Table 3.1.

Table 3.1

Dependent Variable C (Rooms Completed) - Estimation by Least Squares
Quarterly Data From 1971:01 To 1994:04

Usable Observations	96	Degrees of Freedom	89
Centered R**2	0.866765	R Bar **2	0.857783
Uncentered R**2	0.978578	T x R**2	93.943
Mean of Dependent Variable	22256.617409		
Std Error of Dependent Variable	9793.092234		
Standard Error of Estimate	3693.135483		
Sum of Squared Residuals	1213893222.8		
Regression F(6,89)	96.4991		
Significance Level of F	0.00000000		
Durbin-Watson Statistic	0.457816		
Q(24-0)	162.390113		
Significance Level of Q	0.00000000		

Variable	Coeff	Std Error	T-Stat	Signif
1. Constant	-29792.26866	4607.80945	-6.46560	0.00000001
2. S{4}	-0.02584	0.00330	-7.84131	0.00000000
3. R{8}	2056.56004	272.87893	7.53653	0.00000000
4. TNOTES{4}	-52835.35578	24323.93994	-2.17215	0.03250248
5. R%DIFF{4}	79869.18697	15817.75294	5.04934	0.00000234
6. AB{4}	0.04479	0.00751	5.96783	0.00000005
7. C{4}	0.35120	0.07424	4.73090	0.00000835

Equation 3.5

$$\Delta C_{(t)}=0.6488[-45919-0.0398S_{(t-4)}+3169.79R_{(t-8)}-81435.5TNOTES_{(t-4)} +123102.94R\%DIFF_{(t-4)}+0.069AB_{(t-4)}-C_{(t-4)}]$$

The R^2 of 0.866765 in Table 3.1 demonstrates that statistically this model has a fairly good fit (i.e. approximately 87% of the room completions data can be explained by the independent variables). The T-Statistic values for all variables are significant. All the variables are significant to the 96% confidence level. If the variable for treasury notes (TNOTES) is excluded, the remaining variables are significant to the 99% confidence level.

The above room completions adjustment model suggests that in each year almost two thirds (64.88%) of the difference between desired and actual construction will made up.

The room rate elasticity of construction is calculated to be 7.4[52]. This means that for a 1% change in room rate, the construction rate will increase 7.4%. This elasticity is only slightly higher than the 7.3 elasticity reported by Coopers & Lybrand.

The increase in construction also increases the total room stock. As the higher real average room rate spurs construction activity the growing room stock acts as a brake slowing it. With regard to supply, the price elasticity is 1.78[53]. This means that a 1% increase in the real average room rate will result in 1.78%[54] more total room stock.

The signs on the room supply (S) coefficient is negative which means that the larger the existing supply, the more difficult absorption of vacant rooms will be and the less desirable completions are. With regard to interest rates, the sign on the TNOTES coefficient is negative. This means that the lower interest rates are the easier it is to get financing for development. As interest rates increase the ability to arrange financing decreases and development decreases.

Using historical averages of the data series, C* is equal to 23,224 room completions per period[55].

If the market were depressed, at what real average room rate would C* go to zero? With zero absorption and all other variables at historic average values, a real average room rate of $44.17[56] would bring C* to zero. Alternatively, if room

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52 (3169.79*51.5)/22028.13788

53 (2056.56*51.50)/(0.02584*2305322.41)

54 The mean values for the 26 year data series were used for calculations.

55 -45919-(0.0398*2305322)+(3169.79*51.50)-(81435.5*0.08612)+(123102.94*0.01269)+(0.069*44950)

56 R=(45919+(.0398*2305322)+(81435*0.08612)-(123102.94*0.01269)-(0.069*44950))/3169.79

completions[57] was exactly matching room demand, the real average rate would settle at $58.35[58]

The final model to determine on the supply side is that for scrappage. As described in the section on economic obsolescence, scrappage is dependent on a property's ability to have a positive cash flow. Cash flow depends on variables such as the room rate, interest rates and inflation, competition and the state of the economy.

First, as stated in the demand section in Chapter 2, the economy is the main determiner of people's propensity to travel. If the economic trend[59] is positive, more people travel, occupancy rises and properties have more of a chance for a positive cash flow. With a higher cash flow, the scrappage option makes less economic sense so scrappage decreases. Hence, as demonstrated in Chart 3.7, the economy and increases in the economy should be negatively correlated with scrappage.

The scrappage option depends on the cash flow of the property. If there is insufficient cash flow, scrappage becomes the viable alternative. As stated previously, lodging cash flows are based on room rates. If room rates are high, the property has a better chance of a positive cash flow, and vice versa. Therefore, a negative correlation as shown in Chart 3.5, is expected of real average room rates.

Another consideration is the new completions entering the market. The more new properties that enter the market, the more difficult it is for the older properties to compete. Occupancies decrease, cash flow decreases and the scrappage alternative becomes more feasible. As demonstrated in Chart 3.7, room completions, in general, should be positively correlated with scrappage.

Finally, the value of and ability to renovate older properties must be considered. Low real interest rates capitalize properties at a higher value. This

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[57] Historic average of room completions: 44,590

[58] R=(45919+(.0398*2305322)+(81435*0.08612)-(123102.94*0.01269)-(0.069*44950)-44950)/3169.79

[59] GDP is used as a proxy for the economy.

higher value is more difficult to maintain with present room rates hence scrappage becomes an acceptable alternative. Scrappage and real interest rates should be negatively correlated.

Accordingly, the number of rooms to scrap can be determined as a function of the change in the economy, real average room rates, the number of room completions and real interest rates, and can be designated by the variable SCRAP.

Equation 3.6

$$SCRAP_{(t)}=\sigma_0-\sigma_1 GDP\%DIFF-\sigma_2 R_{(t-4)}+\sigma_3 C_{(t)}+\sigma_4 REALRATE_{(t-4)}$$

The coefficient σ_0 determines the baseline number of rooms that would be scrapped, while σ_1, σ_2, σ_3 and σ_4 determine the decrease in room scrappage with respect to economic inflation and room rate growth and the scrappage increase with respect to construction and real rate increases.

The variables are lagged based on when hotel owners consider the market influences in their decision process[60].

The results of the Equation 3.5 regression using the national lodging industry data are presented in Table 3.2.

[60] These lags were chosen for they produced the highest R^2 with coefficients of the correct signs.

Table 3.2

Dependent Variable SCRAP - Estimation by Least Squares
Quarterly Data From 1970:01 To 1994:04

Usable Observations	100	Degrees of Freedom	95
Centered R**2	0.638690	R Bar **2	0.623477
Uncentered R**2	0.814645	T x R**2	81.464
Mean of Dependent Variable	6321.7481477		
Std Error of Dependent Variable	6521.1122901		
Standard Error of Estimate	4001.4485913		
Sum of Squared Residuals	1521101128.7		
Regression F(4,95)	41.9831		
Significance Level of F	0.00000000		
Durbin-Watson Statistic	1.083435		
Q(25-0)	117.493867		
Significance Level of Q	0.00000000		

Variable	Coeff	Std Error	T-Stat	Signif
1. Constant	25145.29388	4014.80746	6.26314	0.00000001
2. GDP%DIFF	-63491.12857	18074.47071	-3.51275	0.00068077
3. R{4}	-486.81195	80.33039	-6.06012	0.00000003
4. C	0.40431	0.04518	8.94865	0.00000000
5. REALRATE{4}	-41156.594	14793.28658	-2.78211	0.00651450

Equation 3.7

$$SCRAP_{(t)}=25145.29388-63491.12857GDP\%DIFF_{(t)}-486.81195R_{(t-4)}+0.40431C_{(t)}-41156.594REALRATE_{(t-4)}$$

The R^2 of 0.638690 in Table 3.2 demonstrates that statistically this model has a reasonable fit (i.e. approximately 63% of the scrappage data can be explained by the independent variables). The T-Statistic values for all variables are significant. All the variables are significant to the 99% confidence level.

The four period lag (1 year) on the real average rate and real interest rate variables is interesting for it says that part of the decision to scrap hotel rooms is based on previous market conditions.

The price elasticity of scrappage is -3.92[61]. This means for a 1% increase in the real average room rate, scrappage declines by 3.92%.

[61] Price Elasticity of Scrappage = (51.50*-486.81195)/ 6396

At what room rate would scrappage cease altogether? Using the historical means of the 26 year data series, the real average room rate would have to increase to $64.08[62] for scrappage to cease.

Summary

Chapter 3 demonstrates how the room stock determines the level of room completions, how the room completions determine scrappage, and how scrappage and room completions together determine the room stock. The combination of Equations 3.1 to 3.6 has created a supply model for the lodging industry that works as follows: [63]

First, given a stock of hotel rooms, the real average room rate, interest rates, real average room rate inflation and room absorption, Equations 3.4 eventually yields a stable number of rooms completed. Equation 3.6 takes this completion level and combines it with real GDP inflation, real average room rates and the real interest rate to determine scrappage. The scrappage and room completions combined yield a new level of room stock in identity Equation 3.1. This new room stock is then used to determine occupancy rates back in Equation 2.6.

Quantitatively, with regard to the completion adjustment model, the existing room stock and interest rates were shown to be negatively correlated with the change in room completions while the real average room rate, room rate inflation, and room absorption were shown to be positive. The room completions adjustment model suggests that in each period 64.88% of the difference between desired and actual construction will made up. The room rate elasticity of construction was calculated at 7.4 which demonstrates that the level of construction is very sensitive to price fluctuations. Furthermore, the room rate elasticity with regard to supply was calculated to be 1.78. This suggests that the total room stock is also sensitive to changes in the real average room rate.

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[62] R=(-25145.29388+(63491.12857*0.02538)-(0.40431*22028)+(41156.594*0.03022))/-486.81195

[63] Denise DiPasquale and William C. Wheaton, The Economics of Real Estate Markets, (Prentice Hall 1995), p.12-15.

For scrappage, the real GDP inflation rate, real average room rates and real interest rates were shown to be negatively correlated while room completions was demonstrated as positive. The room rate elasticity of scrappage was calculated at -3.92 which indicates that scrappage is very sensitive to room rate changes.

CHAPTER 4

Forecasting

Introduction

The two identities and two stochastic equations from Chapter 2 combined with the one identity and two stochastic equations from Chapter 3 constitute a full stock/flow model for the United States lodging industry. When combined, they work as follows.

First, given total room stock, a real average room rate, a forecast of real GDP and a forecast of domestic airline passengers, Equations 2.4 eventually determines the level of room absorption. Equation 2.1 takes this room absorption and determines the total room demand (number of rooms sold) for this period by adding it to the total room demand of the same period last year. Identity Equation 2.6 takes this new number of rooms sold and calculates an occupancy rate given a total stock of space. Equation 2.9 takes this occupancy rate and combines it with an inflation rate forecast, which together adjust the real average room rate. Using Equation 2.1's methodology, the real average room rate is updated by adding the change in the real average room rate to the real average room rate last year.

In Equation 3.4, this real average room rate is combined with a stock of rooms (total supply), rent inflation, the change in demand (room absorption), and a forecast of interest rates to determine the change in the number of rooms completed (construction). Again, the methodology of Equation 2.1 is employed and the present room completions level is updated by adding the change in completions to the number of completions in the same period last year. The completions are combined with the previously determined real average room rate, real GDP inflation (determined from the forecast of GDP) and a real interest rate (determined from the forecasts of inflation and interest rates) to calculate the total amount of room scrappage (demolition) in Equation 3.6. This scrappage level is combined with the previously determined room completions to update the total room stock in identity Equation 3.1. This new room stock is then used to update the occupancy rate in identity Equation 2.6 and the number of room completions in Equation 3.4.

Many of the independent variables have been lagged to demonstrate when they have the greatest influence[64] over the dependent variable and to avoid simultaneity in equations.

The model operates recursively starting in the first forecast period, 1995 Q1. In this period, all endogenous variables are known.

In the following section, two forecast scenarios will be presented and analyzed. The first scenario, Scenario (A), is a base case forecasting conservative real GDP and enplanements (ENPLANE) growth. Interest rates (TNOTES) and Inflation (INF) were projected to remain constant at today's levels.

The second scenario, Scenario (B), introduces a recession and subsequent recovery into the economy (real GDP) starting in 1997 Q3. Enplanement, interest rate and inflation rate forecasts remain the same as they were in Scenario (A).

Exogenous Variables

The raw data for all exogenous data forecasts is listed in Table 4.1.

Gross Domestic Product

As was concluded in Chapter 2, the United States Gross Domestic Product was shown to be a major influence on hotel demand. For both the long term and short term, the demand for lodging was closely synchronized with the economy.

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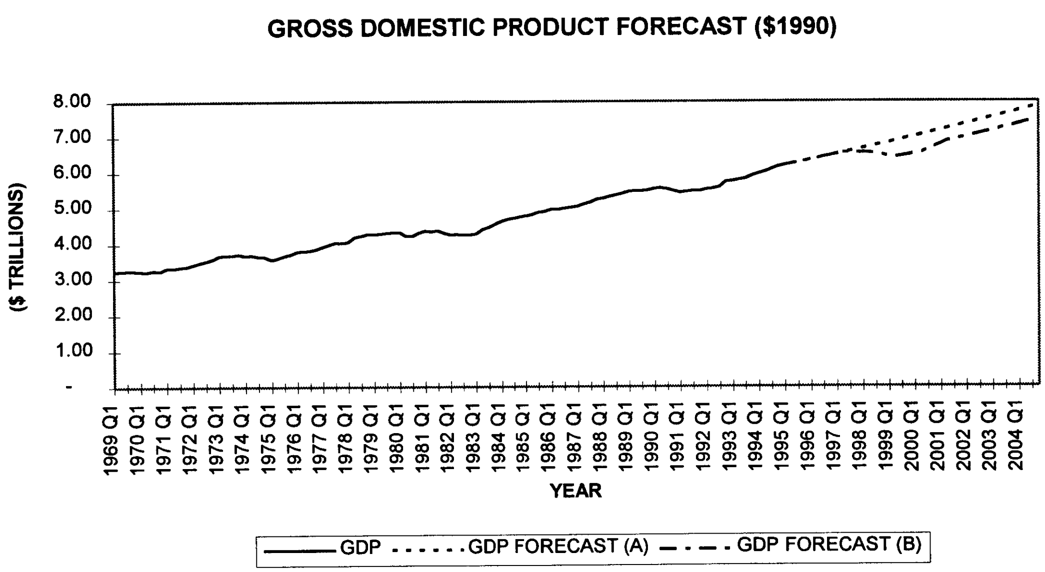
[64] Greatest influence is defined as maximizing the R^2 of the stochastic equation.

Because of the strong relationship, real GDP was chosen to be the test variable for forecasting. Two forecasting scenarios were created with equivalent exogenous variable except for real GDP.

As a base case scenario (Scenario A), the gross domestic product was shown to increase at 2.5% per annum. This represents a realistic, conservative growth based on current real GDP and economic conditions.

Alternatively, Scenario B forecasts similar 2.5% growth until the third quarter of 1997, but then introduces an economic recession and subsequent economic recovery. The annual GDP growth returns to the conservative 2.5% per annum for the year ending in the third quarter of 2002. This scenario was chosen for it mimics historical trends. From the 26 year time series, it appears that the U.S. economy cycles through a similar recession and recovery every seven to eight years. The last cycle was in 1990, therefore, the next cycle should occur in 1997.

Chart 4.1

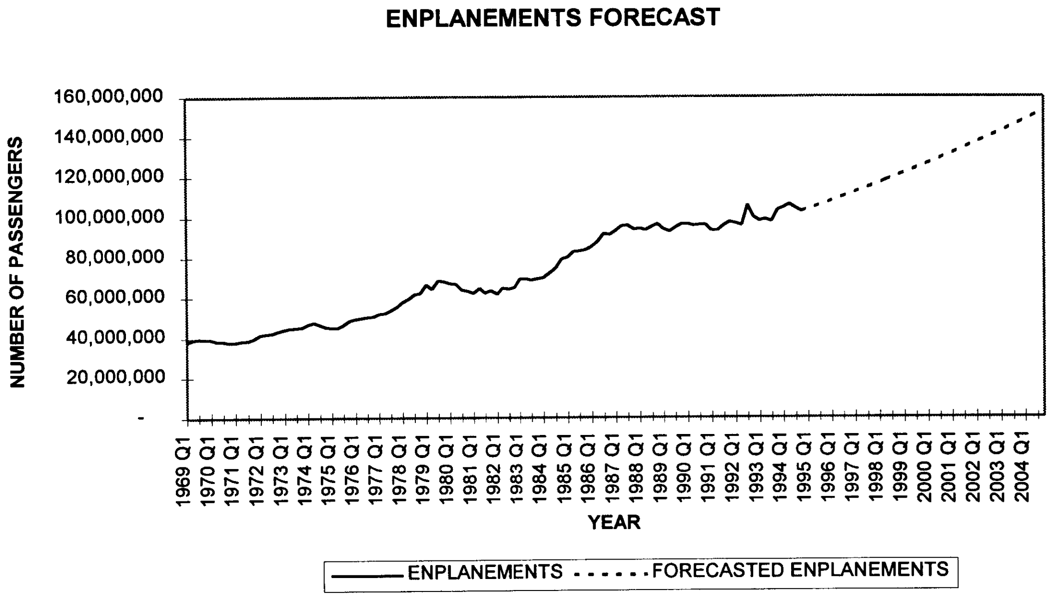


Enplanements

From the raw data, historical enplanements (ENPLANE), defined as the number of domestic airline passengers, was shown to be a cyclical industry. For simplicity purposes, the growth was assumed to be linear at a conservative 1%

per period[65]. This is in line with recent historical growth. This forecast was used for both Scenario A and B.

Chart 4.2

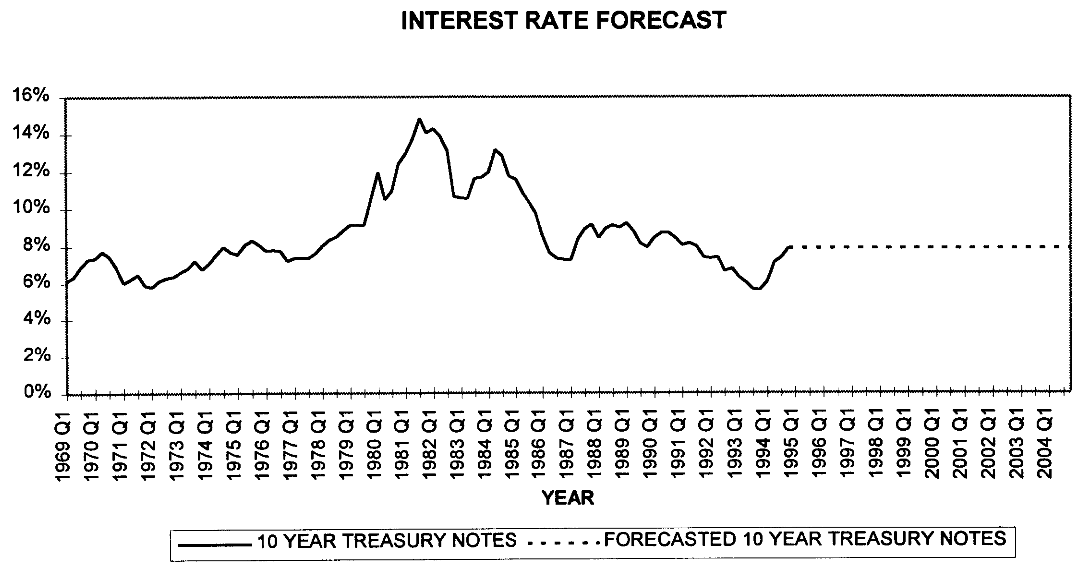


65 For this thesis, a period is defined as a quarter of a year.

Interest Rates

10 Year Treasury Notes (TNOTES) were used to represent interest rates. These were forecast for both Scenario A and B to remain at of 7.84%. This rate was chosen for it is in line with current U.S. interest rates.

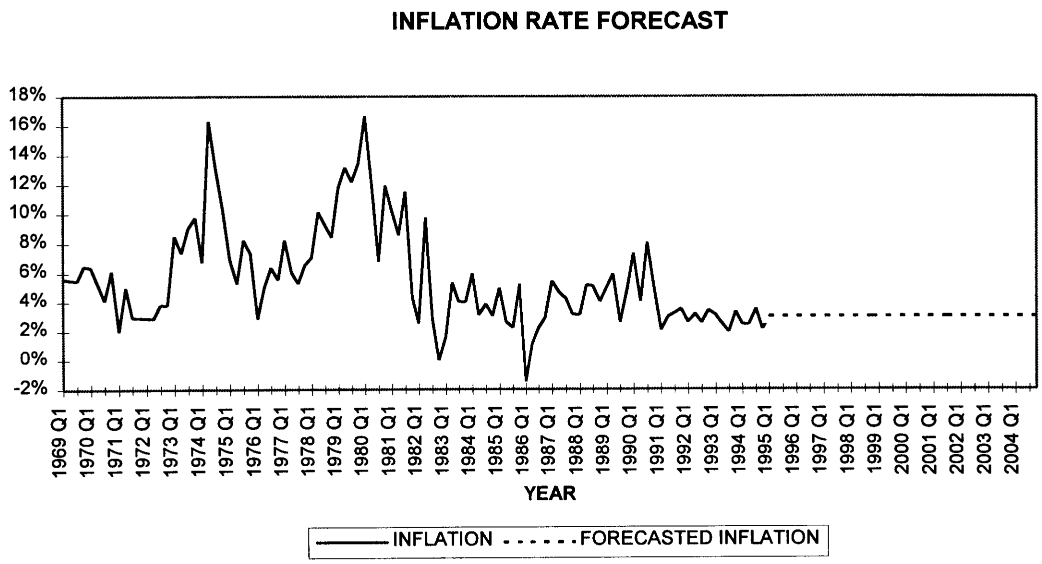
Chart 4.3



Inflation Rates

Inflation rates (INF) were forecast at a constant 3% per annum for both Scenario A and B. This rate was chosen for it is in line with current U.S. inflation.

Chart 4.4



Real Interest Rates

Real Interest Rates were calculated endogenously by subtracting the nominal inflation rate (INF) from the 10 year treasury note rate (TNOTES). With both the interest and inflation rates held to be constant for the ten year forecast period, the real interest rate is calculated to be a steady 4.837%.

Chart 4.5

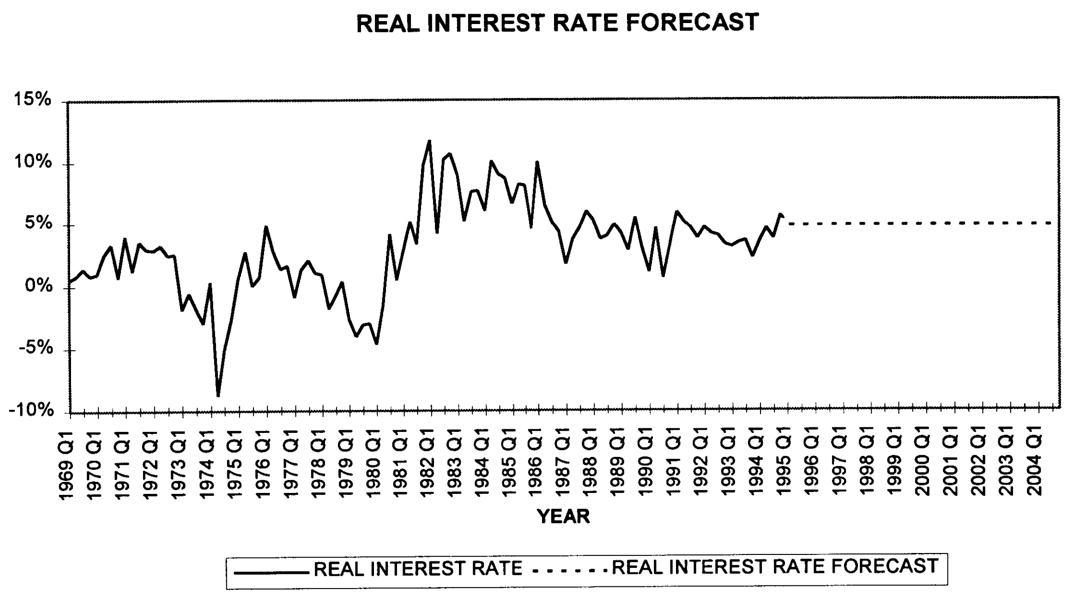


Table 4.1 - Exogenous Variables Forecasts

DATE	GDP(A)	GDP% DIFF(A)	GDP(B)	GDP% DIFF(B)	ENPLANE (A)&(B)	TNOTES (A)&(B)	INF (A)&(B)	REALRATE (A)&(B)
1995 Q1	$ 6,190,129,413,028	3.922%	$ 6,190,129,413,028	3.922%	103,787,883	7.84%	3.00%	4.837%
1995 Q2	$ 6,228,460,219,141	3.523%	$ 6,228,460,219,141	3.523%	104,825,761	7.84%	3.00%	4.837%
1995 Q3	$ 6,267,028,379,047	3.137%	$ 6,267,028,379,047	3.137%	105,874,019	7.84%	3.00%	4.837%
1995 Q4	$ 6,305,835,362,500	2.500%	$ 6,305,835,362,500	2.500%	106,932,759	7.84%	3.00%	4.837%
1996 Q1	$ 6,344,882,648,354	2.500%	$ 6,344,882,648,354	2.500%	108,002,087	7.84%	3.00%	4.837%
1996 Q2	$ 6,384,171,724,619	2.500%	$ 6,384,171,724,619	2.500%	109,082,108	7.84%	3.00%	4.837%
1996 Q3	$ 6,423,704,088,523	2.500%	$ 6,423,704,088,523	2.500%	110,172,929	7.84%	3.00%	4.837%
1996 Q4	$ 6,463,481,246,563	2.500%	$ 6,463,481,246,563	2.500%	111,274,658	7.84%	3.00%	4.837%
1997 Q1	$ 6,503,504,714,562	2.500%	$ 6,503,504,714,562	2.500%	112,387,405	7.84%	3.00%	4.837%
1997 Q2	$ 6,543,776,017,735	2.500%	$ 6,543,776,017,735	2.500%	113,511,279	7.84%	3.00%	4.837%
1997 Q3	$ 6,584,296,690,736	2.500%	$ 6,543,776,017,735	1.869%	114,646,391	7.84%	3.00%	4.837%
1997 Q4	$ 6,625,068,277,727	2.500%	$ 6,543,776,017,735	1.242%	115,792,855	7.84%	3.00%	4.837%
1998 Q1	$ 6,666,092,332,426	2.500%	$ 6,543,776,017,735	0.619%	116,950,784	7.84%	3.00%	4.837%
1998 Q2	$ 6,707,370,418,178	2.500%	$ 6,543,776,017,735	0.000%	118,120,292	7.84%	3.00%	4.837%
1998 Q3	$ 6,748,904,108,005	2.500%	$ 6,510,808,843,179	-0.504%	119,301,495	7.84%	3.00%	4.837%
1998 Q4	$ 6,790,694,984,670	2.500%	$ 6,478,007,755,389	-1.005%	120,494,510	7.84%	3.00%	4.837%
1999 Q1	$ 6,832,744,640,737	2.500%	$ 6,445,371,917,629	-1.504%	121,699,455	7.84%	3.00%	4.837%
1999 Q2	$ 6,875,054,678,633	2.500%	$ 6,412,900,497,380	-2.000%	122,916,449	7.84%	3.00%	4.837%
1999 Q3	$ 6,917,626,710,705	2.500%	$ 6,444,727,283,734	-1.015%	124,145,614	7.84%	3.00%	4.837%
1999 Q4	$ 6,960,462,359,286	2.500%	$ 6,476,712,024,252	-0.020%	125,387,070	7.84%	3.00%	4.837%
2000 Q1	$ 7,003,563,256,756	2.500%	$ 6,508,855,502,847	0.985%	126,640,941	7.84%	3.00%	4.837%
2000 Q2	$ 7,046,931,045,599	2.500%	$ 6,541,158,507,328	2.000%	127,907,350	7.84%	3.00%	4.837%
2000 Q3	$ 7,090,567,378,473	2.500%	$ 6,621,433,137,967	2.742%	129,186,423	7.84%	3.00%	4.837%
2000 Q4	$ 7,134,473,918,269	2.500%	$ 6,702,692,917,693	3.489%	130,478,288	7.84%	3.00%	4.837%
2001 Q1	$ 7,178,652,338,174	2.500%	$ 6,784,949,936,484	4.242%	131,783,071	7.84%	3.00%	4.837%
2001 Q2	$ 7,223,104,321,738	2.500%	$ 6,868,216,432,694	5.000%	133,100,901	7.84%	3.00%	4.837%
2001 Q3	$ 7,267,831,562,934	2.500%	$ 6,910,746,120,663	4.369%	134,431,910	7.84%	3.00%	4.837%
2001 Q4	$ 7,312,835,766,225	2.500%	$ 6,953,539,162,936	3.742%	135,776,229	7.84%	3.00%	4.837%
2002 Q1	$ 7,358,118,646,629	2.500%	$ 6,996,597,190,268	3.119%	137,133,992	7.84%	3.00%	4.837%
2002 Q2	$ 7,403,681,929,782	2.500%	$ 7,039,921,843,512	2.500%	138,505,332	7.84%	3.00%	4.837%
2002 Q3	$ 7,449,527,352,008	2.500%	$ 7,083,514,773,680	2.500%	139,890,385	7.84%	3.00%	4.837%
2002 Q4	$ 7,495,656,660,381	2.500%	$ 7,127,377,642,010	2.500%	141,289,289	7.84%	3.00%	4.837%
2003 Q1	$ 7,542,071,612,794	2.500%	$ 7,171,512,120,025	2.500%	142,702,182	7.84%	3.00%	4.837%
2003 Q2	$ 7,588,773,978,026	2.500%	$ 7,215,919,889,599	2.500%	144,129,204	7.84%	3.00%	4.837%
2003 Q3	$ 7,635,765,535,808	2.500%	$ 7,260,602,643,022	2.500%	145,570,496	7.84%	3.00%	4.837%
2003 Q4	$ 7,683,048,076,891	2.500%	$ 7,305,562,083,060	2.500%	147,026,200	7.84%	3.00%	4.837%
2004 Q1	$ 7,730,623,403,114	2.500%	$ 7,350,799,923,025	2.500%	148,496,463	7.84%	3.00%	4.837%
2004 Q2	$ 7,778,493,327,477	2.500%	$ 7,396,317,886,839	2.500%	149,981,427	7.84%	3.00%	4.837%
2004 Q3	$ 7,826,659,674,203	2.500%	$ 7,442,117,709,097	2.500%	151,481,241	7.84%	3.00%	4.837%
2004 Q4	$ 7,875,124,278,813	2.500%	$ 7,488,201,135,136	2.500%	152,996,054	7.84%	3.00%	4.837%

Endogenous Variables

Having forecast all exogenous variables in the above section, the endogenous variables can now be calculated. As was mentioned in Chapter 3, scrappage was calculated as negative in some years. To correct for this discrepancy, scrappage was set to zero in years that it was calculated as negative. Without this correction, the total stock of hotel rooms would be overestimated which in turn would skew the other endogenous variables. The data for forecasted endogenous demand variables is presented in Table 4.2 and for supply variables in Table 4.3.

Room Absorption

In Chapter 2, Equation 2.5, the room absorption or change in the number of rooms sold was calculated as a function of current average room rates, current GDP, current enplanements and lagged room demand (number of rooms sold).

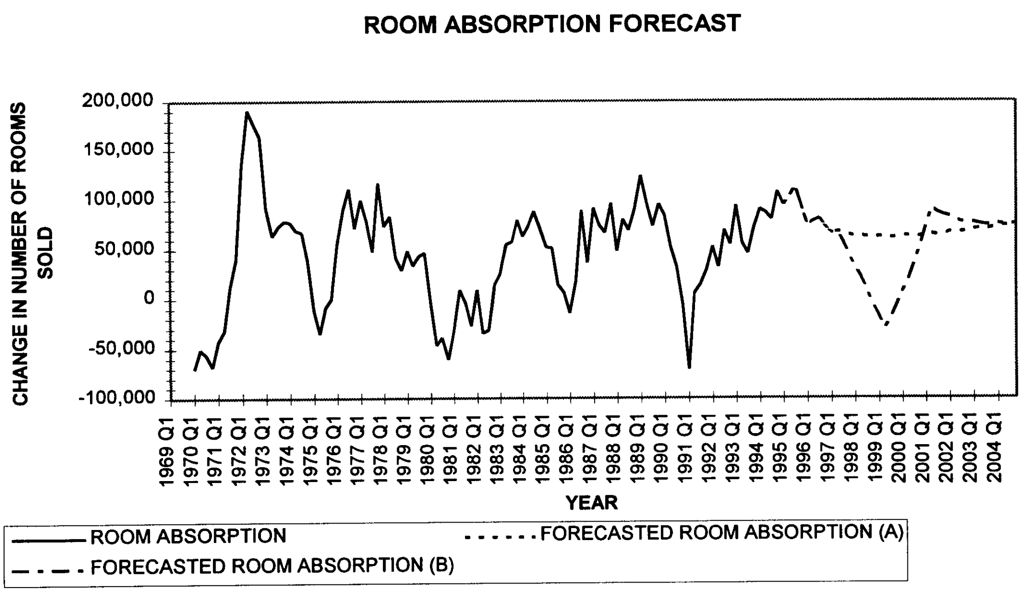
Using the Scenario A data, room absorption remains at a somewhat constant level for the 10 year forecast period. After 1996, the change in the number of rooms sold decreases from approximately 73, 000 to a low of 62,000 around 1999 and increasing again to 75,000 at the end of the forecast period. The annual fluctuations after 1996 are predominately calculated at less than 0.03%.

Alternatively, Scenario B demonstrates the sensitivity of room demand to GDP. The 1997 recession causes a severe decrease in room demand that reaches its nadir in mid-1999. The subsequent economic recovery catapults the room demand past Scenario A's within one and a half years but finally settles back at Scenario A's level at the end of 2004. Quarterly fluctuations are dramatic with changes exceeding 100% or more during the peak recession period.

Referring to the historical observations, Scenario B's forecast appears to perpetuate room absorption's cycle of a drop and subsequent two year recovery period. This is consistent with the 0.58 adjustment factor from the room demand adjustment model.

The year 1991, which was the low point of the last absorption cycle, was the last year new stock from the late 1980's building boom entered the lodging market. A significant portion of this stock had been absorbed by 1993. With the little new construction in recent years, room absorption has reached a cyclical historical apex in 1995 which should spur development.

Chart 4.6



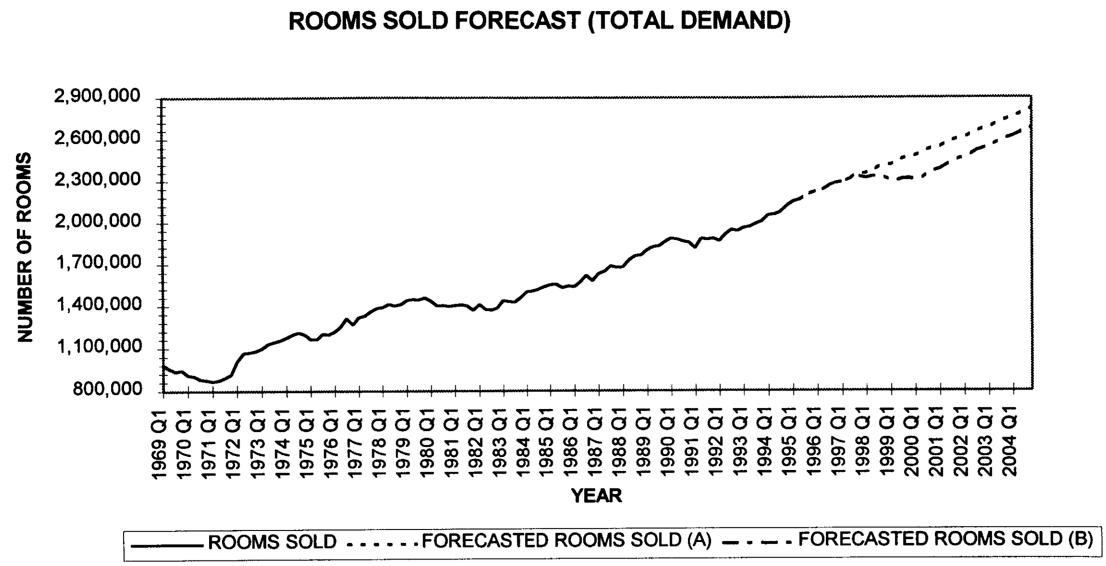
Number of Rooms Sold (Demand)

In Chapter 2, Equation 2.1, the number of rooms sold was calculated as an identity equation using current room absorption added to last years room demand.

In Scenario A, room demand constantly grows at an average rate of 0.71% per quarter culminating in a room demand of 2,819,633 units in 2004 Q4.

For scenario B the room demand grows at an average of 0.59% culminating in a room demand of 2,684,009 units in 2004 Q4. This is a 4.8% difference from Scenario A. Where Scenario A's growth is always positive, Scenario B experiences some negative growth quarters in 1998 and 1999. After 1999 the demand growth accelerates reaching a high of 1.32% in the 2000 Q3.

Chart 4.7



Occupancy Rate

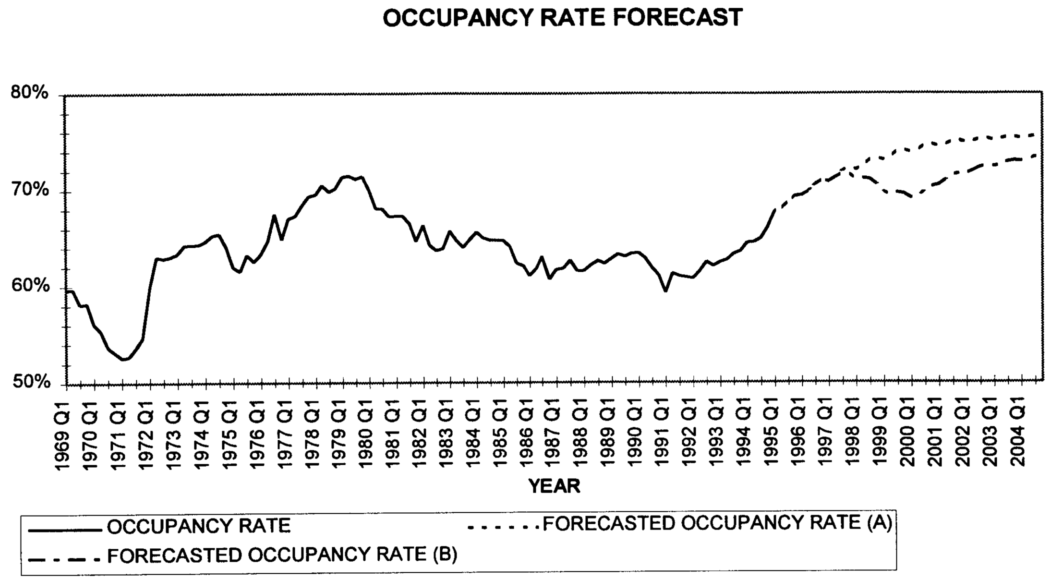
In Chapter 2, Equation 2.6, the identity equation for the occupancy rate was calculated as a ratio of current room demand divided by the total room stock.

In Scenario A the occupancy rate grows at an average of 0.23% but does experience some minor negative changes (less than 0.2%) in a few quarters. The occupancy rate achieves 75.5% at the end of the forecast period.

Scenario B experiences an average growth rate of 0.18% per quarter but oscillates between positive and negative more often. The occupancy rate in Scenario B dips as low as 69.21% in the year 2000 but recovers by mid-2001 and rises to 73.48% at the end of the forecast. This is approximately 2% less than Scenario A's occupancy rate.

Regardless of the scenario used, both culminate in a historically high occupancy rate spurred on by room demand increase.

Chart 4.8



Real Average Room Rate

In Chapter 2, Equation 2.10, the change in the real average room rate was calculated as a function of the lagged variables: occupancy rate, inflation rate, and real average room rate. The real average room rate was calculated using the methodology of Equation 2.1 whereby the real average rate this period is equal to the change in the real average rate added to the real average rate in last years corresponding period.

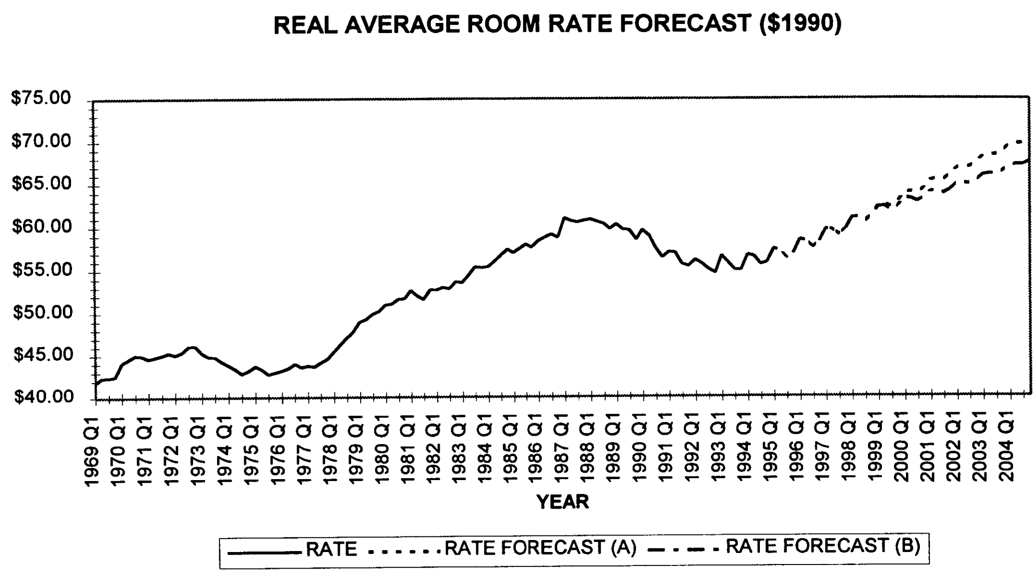
In both Scenario A and B the real average room rate reaches a historic high of $70.17 and $67.62 respectively (a 3.8% difference). In both scenarios, the real average room rate recovers past its 1988 maximum in 1998.

With inflation being held constant in both simulations all changes are attributable to the occupancy rate changes.

In Chapter 2 it was shown that the real average room rate adjusts very slowly at 8.3% per year. This slow adjustment rate minimizes the negative impact of the recession on occupancy in Scenario B. This slow adjustment leads to a steady rate increase over the 10 year period.

This constant room rate increase slowly returns real average room rates to the average trend line of the twenty-six year data series. Near the end of the forecast period, the real average room rate may barely surpass it.

Chart 4.9



Room Completions (Construction)

In Chapter 3, Equation 3.5, the change in the number of rooms completed (construction) was calculated as a function of last year's values for total room stock, interest rates, room rate inflation, room absorption and room completions and the real average room rate from two years ago. The number of completions this period was then calculated using the methodology of Equation 2.1 whereby the current room completions equals the change in the number of room completions added to the room completions in last years corresponding period.

As was determined in Chapter 3, the construction level adjusts itself very quickly to market changes. Construction will head toward its target level at 64% per year.

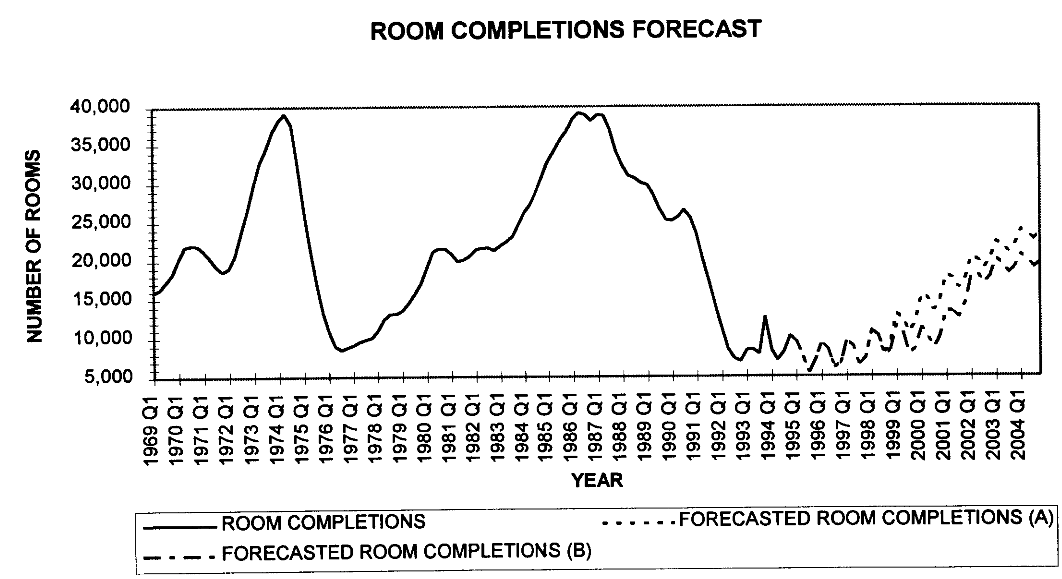
In Scenario A, the number of completed rooms grows at an average of 3.75% per quarter during the entire forecast period versus only 3.57% in Scenario B.

The recession in Scenario B puts a damper on a recovering lodging development market until mid-2000. After 2000, the recovery steadily accelerates completions from approximately 10,0000 rooms per quarter to over 19,500 rooms per quarter by the end of the forecast period.

By combining the time series data and forecast data it can be seen that 1994 to 1996 is a historical development low for the lodging industry. Therefore, from this forecast it can be argued that regardless of which scenario is used, lodging development is on the cusp of a building surge driven by the steady increase in room rates. As was calculated in Chapter 2, the price elasticity of construction is 7.3 which is a very elastic relationship.

It should be pointed out that this increase in construction will not equal the building booms of the mid-1980's or early 1970's. As was explained in the real average room rate section above, the room rate is returning to the time series trend line from a low period in the early 1990's. For there to be a boom, the real average room rate would have to considerably exceed the real average room rate data series trend line. Therefore, while there will be increased development for the next ten years, it will be moderate and perhaps at half the rate experienced in the mid-1980's.

Chart 4.10



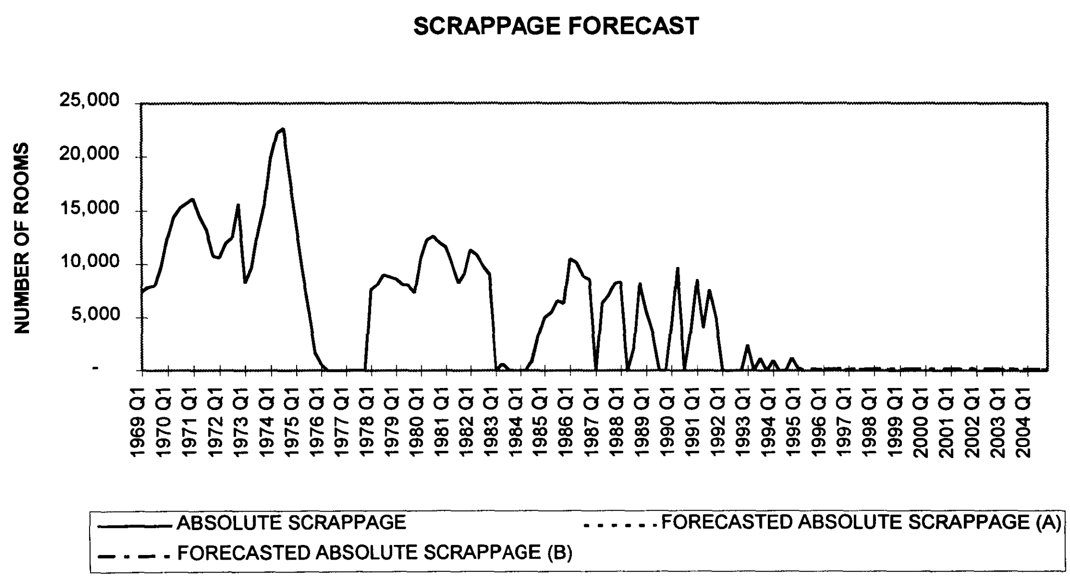
Scrappage (Demolition)

In Chapter 3, Equation 3.7, the number of rooms scrapped this period was calculated as a function of the current change in real GDP, last year's real average room rate, the current number of room completions and last year's real interest rate.

In both scenarios, scrappage effectively goes to zero. As is being shown above, the lodging industry is about to enter a growth mode. Occupancy and real average room rates are headed towards historical highs which improves the cash flows of all properties.

Again, the real average room rate has the greatest influence over scrappage and with it trending upwards for the next decade, economic obsolescence diminishes. This forecast demonstrates the Chapter 3 price elasticity of scrappage calculation of -3.92.

Chart 4.11



Room Stock (Total Supply)

In Chapter 3, Equation 3.1, the identity equation for the total room stock was calculated as last years total room stock plus current room completions minus current room scrappage.

Regardless of the scenario chosen the room stock is increasing to historic highs due to the anticipated high construction levels. For Scenario A the room stock increases an average of 0.41% per period to 3,731,447 units in 2004. For Scenario B the room stock increases an average of 0.36% per period to 3,652,793 units in 2004. This is a difference of only 0.05%.

With the moderate increase in construction forecasted above, the total room stock will only increase a little more than 1.1%. Keeping all else equal, if real average room rates keep adjusting at the same steady rate, the ultimate total room stock increase would reach only be 1.78%.

Chart 4.12

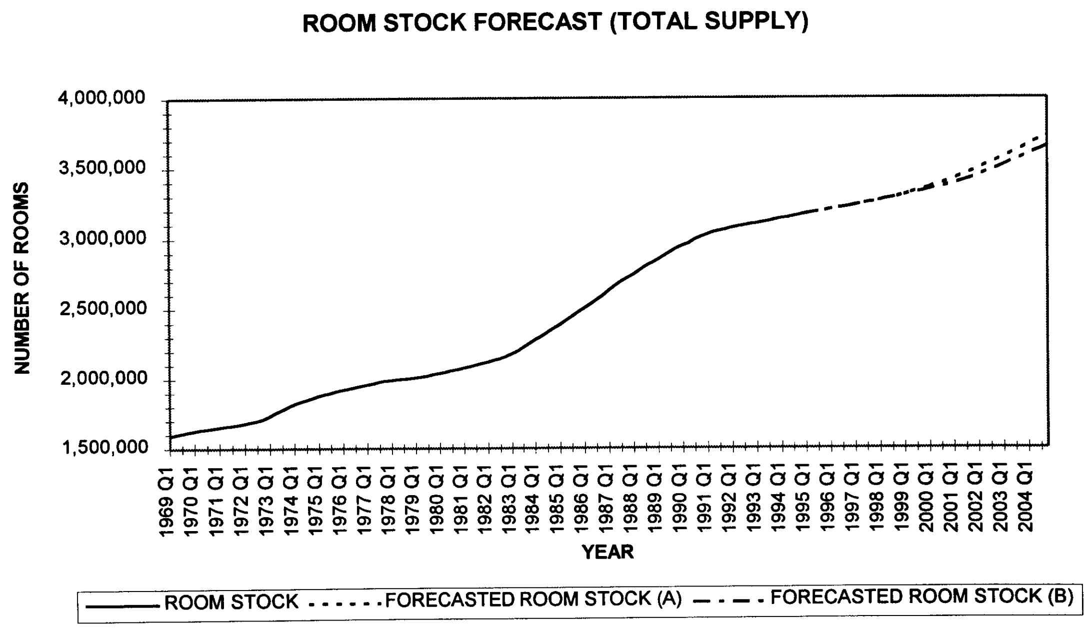


Table 4.2 - Endogenous Demand Variable Forecast Data

DATE	AB (A)	AB (B)	SOLD (A)	SOLD (B)	OC (A)	OC (B)	R (A)	R (B)
1995 Q1	94,417	94,417	2,150,017	2,150,017	67.79%	67.79%	$57.42	$57.42
1995 Q2	103,317	103,317	2,164,817	2,164,817	68.09%	68.09%	$57.24	$57.24
1995 Q3	112,580	112,580	2,189,380	2,189,380	68.75%	68.75%	$56.32	$56.32
1995 Q4	92,598	92,598	2,214,598	2,214,598	69.39%	69.39%	$56.89	$56.89
1996 Q1	74,856	74,856	2,224,873	2,224,873	69.50%	69.50%	$58.47	$58.47
1996 Q2	78,312	78,312	2,243,129	2,243,129	69.89%	69.89%	$58.36	$58.36
1996 Q3	81,006	81,006	2,270,387	2,270,387	70.60%	70.60%	$57.62	$57.62
1996 Q4	72,692	72,692	2,287,290	2,287,290	70.98%	70.98%	$58.24	$58.24
1997 Q1	66,597	66,597	2,291,469	2,291,469	70.90%	70.90%	$59.71	$59.71
1997 Q2	67,770	67,770	2,310,899	2,310,899	71.30%	71.30%	$59.66	$59.66
1997 Q3	67,822	57,359	2,338,208	2,327,746	72.00%	71.68%	$59.10	$59.10
1997 Q4	64,655	43,665	2,351,945	2,330,955	72.26%	71.62%	$59.73	$59.73
1998 Q1	63,518	31,936	2,354,987	2,323,405	72.11%	71.15%	$61.06	$61.06
1998 Q2	63,785	21,545	2,374,683	2,332,443	72.49%	71.20%	$61.08	$61.08
1998 Q3	62,891	7,977	2,401,100	2,335,723	73.11%	71.13%	$60.67	$60.62
1998 Q4	61,997	(5,576)	2,413,941	2,325,379	73.29%	70.64%	$61.29	$61.19
1999 Q1	62,897	(17,320)	2,417,884	2,306,085	73.13%	69.80%	$62.49	$62.34
1999 Q2	62,881	(29,967)	2,437,565	2,302,476	73.44%	69.47%	$62.56	$62.36
1999 Q3	61,799	(18,977)	2,462,898	2,316,747	73.97%	69.73%	$62.29	$61.93
1999 Q4	61,931	(6,785)	2,475,872	2,318,595	74.09%	69.61%	$62.88	$62.37
2000 Q1	63,615	6,943	2,481,499	2,313,027	73.92%	69.21%	$63.95	$63.30
2000 Q2	63,598	18,956	2,501,163	2,321,432	74.17%	69.25%	$64.07	$63.27
2000 Q3	62,653	35,424	2,525,552	2,352,170	74.59%	69.99%	$63.90	$62.92
2000 Q4	63,275	53,645	2,539,147	2,372,240	74.67%	70.37%	$64.46	$63.30
2001 Q1	65,214	73,370	2,546,713	2,386,397	74.49%	70.51%	$65.42	$64.09
2001 Q2	65,313	91,448	2,566,476	2,412,881	74.68%	71.01%	$65.57	$64.07
2001 Q3	64,628	87,382	2,590,179	2,439,553	75.02%	71.53%	$65.48	$63.86
2001 Q4	65,501	84,767	2,604,648	2,457,006	75.05%	71.74%	$66.00	$64.27
2002 Q1	67,475	83,142	2,614,188	2,469,540	74.89%	71.73%	$66.85	$65.01
2002 Q2	67,725	79,681	2,634,201	2,492,561	75.03%	72.02%	$67.02	$65.08
2002 Q3	67,321	77,567	2,657,500	2,517,120	75.29%	72.38%	$66.99	$64.96
2002 Q4	68,329	76,843	2,672,977	2,533,849	75.30%	72.48%	$67.48	$65.38
2003 Q1	70,249	77,007	2,684,437	2,546,547	75.15%	72.43%	$68.23	$66.05
2003 Q2	70,642	75,614	2,704,843	2,568,175	75.25%	72.64%	$68.41	$66.16
2003 Q3	70,494	74,578	2,727,995	2,591,698	75.45%	72.92%	$68.42	$66.11
2003 Q4	71,573	74,762	2,744,550	2,608,611	75.45%	73.01%	$68.87	$66.50
2004 Q1	73,401	75,684	2,757,838	2,622,231	75.32%	72.97%	$69.54	$67.12
2004 Q2	73,911	75,271	2,778,754	2,643,447	75.40%	73.14%	$69.71	$67.24
2004 Q3	73,975	74,815	2,801,969	2,666,513	75.57%	73.39%	$69.75	$67.24
2004 Q4	75,083	75,398	2,819,633	2,684,009	75.56%	73.48%	$70.17	$67.62

Table 4.2 - Endogenous Supply Variable Forecast Data

DATE	C (A)	C (B)	S (A)	S (B)	SCRAP (A)	SCRAP (B)
1995 Q1	9,599	9,599	3,171,656	3,171,656	0	0
1995 Q2	7,474	7,474	3,179,131	3,179,131	0	0
1995 Q3	5,402	5,402	3,184,532	3,184,532	0	0
1995 Q4	7,146	7,146	3,191,678	3,191,678	0	0
1996 Q1	9,407	9,407	3,201,085	3,201,085	0	0
1996 Q2	8,489	8,489	3,209,574	3,209,574	0	0
1996 Q3	6,167	6,167	3,215,741	3,215,741	0	0
1996 Q4	6,661	6,661	3,222,402	3,222,402	0	0
1997 Q1	9,611	9,611	3,232,013	3,232,013	0	0
1997 Q2	8,955	8,955	3,240,969	3,240,969	0	0
1997 Q3	6,497	6,497	3,247,465	3,247,465	0	0
1997 Q4	7,350	7,350	3,254,815	3,254,815	0	0
1998 Q1	10,906	10,906	3,265,721	3,265,721	0	0
1998 Q2	10,363	10,363	3,276,084	3,276,084	0	0
1998 Q3	8,079	7,611	3,284,164	3,283,695	0	0
1998 Q4	9,311	8,372	3,293,475	3,292,067	0	0
1999 Q1	13,013	11,600	3,306,489	3,303,667	0	0
1999 Q2	12,567	10,676	3,319,056	3,314,343	0	0
1999 Q3	10,582	7,904	3,329,638	3,322,247	0	0
1999 Q4	11,987	8,535	3,341,626	3,330,781	0	0
2000 Q1	15,510	11,299	3,357,136	3,342,080	0	0
2000 Q2	15,148	10,187	3,372,283	3,352,267	0	0
2000 Q3	13,472	8,605	3,385,756	3,360,872	0	0
2000 Q4	14,878	10,138	3,400,634	3,371,010	0	0
2001 Q1	18,054	13,476	3,418,687	3,384,486	0	0
2001 Q2	17,748	13,349	3,436,436	3,397,834	0	0
2001 Q3	16,341	12,528	3,452,777	3,410,362	0	0
2001 Q4	17,640	14,448	3,470,417	3,424,811	0	0
2002 Q1	20,403	17,862	3,490,820	3,442,672	0	0
2002 Q2	20,124	18,240	3,510,944	3,460,913	0	0
2002 Q3	18,927	16,905	3,529,871	3,477,818	0	0
2002 Q4	20,064	17,911	3,549,934	3,495,729	0	0
2003 Q1	22,404	20,120	3,572,338	3,515,848	0	0
2003 Q2	22,124	19,691	3,594,462	3,535,539	0	0
2003 Q3	21,081	18,385	3,615,543	3,553,924	0	0
2003 Q4	22,032	19,082	3,637,575	3,573,006	0	0
2004 Q1	23,971	20,776	3,661,546	3,593,782	0	0
2004 Q2	23,669	20,230	3,685,215	3,614,013	0	0
2004 Q3	22,735	19,102	3,707,950	3,633,114	0	0
2004 Q4	23,497	19,679	3,731,447	3,652,793	0	0

Summary

With the steady economic growth predicted in Scenario A, all endogenous variables experience steady growth throughout the next decade. With absorption at a six year high, the room demand has been increasing. The increased room demand increases occupancy rates. The increased occupancy rates raise the real average room rate. The very elastic relationship between real average room rates and construction spurs construction. The elastic relationship between real average room rates and scrappage also decreases scrappage to zero. These effects combined slowly raise the room stock. The slow adjustment rate of the real average room rate maintains this construction increase for the next decade.

Scenario B's forecast is similar to Scenario A's. With the two year recession, room demand does drop but quickly recovers within a year and a half of the recession. This does cause a downward trend in occupancy for about three years. The slow adjustment rate on the real average room rate equation means that the room rate decreases only slightly. This decrease slows construction.

With the recovery, Scenario B's demand increases which increases occupancy rates. This increased occupancy rate (though small) spurs construction due to the elastic relationship between room rate and construction. The slow adjustment from the room rate occupancy relationship means that construction continues. The new construction raises the room stock which will ultimately lower occupancy rates, but this is not apparent in the forecast horizon.

Considering either scenario, it appears that now is a good time to invest into the lodging industry. Room rates are forecasted to climb to historic highs as is occupancy. As a developer, completions are now at a cyclical low while absorption is at a cyclical high. These findings suggest that now is the opportune time to begin development on new properties. This development cycle is just now beginning and will increase over the next ten years.

Overall, construction increases will be much more conservative than the last building boom in the 1980's causing the total room stock to increase only 1.1%

CHAPTER 5

Conclusion

This chapter will discuss what has been learned about the United States lodging market. The findings and conclusions from the analyses in the previous chapters will be summarized below.

First, hotel room absorption was shown to be strongly, positively correlated with real GDP in both the long term and the short term. U.S. domestic enplanements were also shown to be positively correlated to room absorption but to a much lesser extent. The adjustment model was completed with real average room rates which were shown to be negatively correlated with room absorption. Collectively, the variables demonstrate that 58% of the total number of travelers will adjust their room consumption each year.

With regard to the real average room rate alone, it was calculated that a 1% increase in the real average room rate, will decrease the room absorption by 0.47%.

Next, the real average room rate was shown to be positively correlated and vary primarily with the occupancy rate. It was calculated that a 1% increase in the occupancy would increase the average rate by 2.3%. Alternatively, inflation was shown to a lesser extent to negatively influence the real average room rate.

When combined, the adjustment factor was calculated at only 0.083. This means that for any changes in these variables, the hotel operators will only adjust their real average room rate by 8.3% per year. This is a very slow adjustment factor that relates back to the absorption model price inelasticity of demand.

The number of room completions was then also calculated as an adjustment model. It was shown to be positively influenced by increases in the real average room rate, room rate inflation and room absorption. Alternatively, it was also demonstrated to be negatively correlated with increases in interest rates and the existing room stock. Altogether, the model had an adjustment factor of 0.6488. This means that in each year, almost 65% of the developers adjust their construction level towards the target level. This change is very dependent on real average room rates for it was calculated that a 1% increase in the real average rate will increase room completions by 7.3%.

This quick construction level also alters the total room stock which then acts as a damper on construction. For each 1% increase in room stock, the real average room rate decreases 1.78%.

Finally, the room scrappage was determined. It was shown that room scrappage decreases with increases in real GDP, real average room rates and real interest rates. These variables all increase the financial viability of a property decreasing the scrappage option value. Alternatively, scrappage was shown to increase with increases in room completions. With regard to the real average room rate, room scrappage was shown to decrease 3.92% for every 1% increase in real average room rates.

For scrappage, the real GDP inflation rate, real average room rates and real interest rates were shown to be negatively correlated while room completions was demonstrated as positive. The price elasticity of scrappage was calculated at -3.92 which indicates that scrappage is very sensitive to room rate changes.

The models were then tested on two forecasting scenarios. Scenario (A) forecasted steady 2.5% annual GDP growth, quarterly enplanement growth of 1% and constant interest rates and inflation rates at 7.84% and 3% respectively. Scenario (B) maintained similar forecasts for enplanements, inflation and interest rates but introduced an economic recession and subsequent recovery in 1995.

With the steady economic growth predicted in Scenario A, all endogenous variables experience steady growth throughout the next decade. With absorption at a six year high, the room demand has been increasing. The increased room demand increases occupancy rates. The increased occupancy rates raise the real average room rate. The very elastic relationship between real average room rates and construction spurs construction. The elastic relationship between real average room rates and scrappage also decreases scrappage to zero. These effects combined slowly raise the room stock. The slow adjustment rate of the real average room rate maintains this construction increase for the next decade.

Scenario B's forecast is similar to Scenario A's. With the two year recession, room demand does drop but quickly recovers within a year and a half of the recession. This does cause a downward trend in occupancy for about three years. The slow adjustment rate on the real average room rate equation means that the room rate decreases only slightly. This decrease slows construction.

With the recovery, Scenario B's demand increases which increases occupancy rates. This increased occupancy rate (though small) spurs construction due to the elastic relationship between room rate and construction. The slow adjustment from the room rate occupancy relationship means that construction continues. The new construction raises the room stock which will ultimately lower occupancy rates, but this is not apparent in the forecast horizon.

Considering either scenario, it appears that now is a good time to invest into the lodging industry. Room rates are forecasted to climb to historic highs as is occupancy. As a developer, completions are now at a cyclical low while absorption is at a cyclical high. These findings suggest that now is the opportune time to begin development on new properties. This development cycle is just now beginning and will increase over the next ten years.

Overall, construction increases will be much more conservative than the last building boom in the 1980's causing the total room stock to increase only 1.1%

APPENDICES

Table A1 - Observation Data Set for Exogenous Variables

DATE	GDP ($1990)	ENPLANE	TNOTES	INF	REALRATE
1969 Q1	$ 3,246,410,200,000	38,277,281	6.12%	5.62%	0.499%
1969 Q2	$ 3,252,184,300,000	39,221,513	6.35%	5.54%	0.813%
1969 Q3	$ 3,269,619,900,000	39,694,075	6.86%	5.46%	1.393%
1969 Q4	$ 3,261,355,000,000	39,260,517	7.30%	6.47%	0.828%
1970 Q1	$ 3,251,844,700,000	39,455,825	7.37%	6.37%	1.001%
1970 Q2	$ 3,237,352,800,000	38,439,254	7.71%	5.22%	2.491%
1970 Q3	$ 3,279,356,600,000	38,461,668	7.46%	4.12%	3.336%
1970 Q4	$ 3,255,354,400,000	37,753,664	6.85%	6.12%	0.731%
1971 Q1	$ 3,336,644,900,000	37,785,785	6.02%	2.01%	4.007%
1971 Q2	$ 3,344,230,500,000	38,546,879	6.25%	5.00%	1.247%
1971 Q3	$ 3,365,741,900,000	38,729,498	6.48%	2.96%	3.520%
1971 Q4	$ 3,381,365,900,000	39,768,070	5.89%	2.94%	2.949%
1972 Q1	$ 3,441,937,500,000	41,556,036	5.80%	2.92%	2.880%
1972 Q2	$ 3,498,433,300,000	41,995,690	6.14%	2.90%	3.245%
1972 Q3	$ 3,537,606,700,000	42,326,062	6.29%	3.84%	2.453%
1972 Q4	$ 3,593,083,400,000	43,340,788	6.37%	3.80%	2.573%
1973 Q1	$ 3,682,072,700,000	44,161,017	6.60%	8.47%	-1.867%
1973 Q2	$ 3,699,395,000,000	44,852,314	6.81%	7.37%	-0.567%
1973 Q3	$ 3,696,451,400,000	45,050,246	7.21%	9.05%	-1.843%
1973 Q4	$ 3,724,529,400,000	45,329,331	6.75%	9.73%	-2.981%
1974 Q1	$ 3,690,224,400,000	46,721,720	7.05%	6.74%	0.315%
1974 Q2	$ 3,699,508,300,000	47,447,803	7.54%	16.31%	-8.769%
1974 Q3	$ 3,667,241,200,000	46,573,106	7.96%	13.06%	-5.098%
1974 Q4	$ 3,652,862,500,000	45,437,575	7.67%	10.28%	-2.607%
1975 Q1	$ 3,570,892,700,000	45,024,407	7.54%	6.94%	0.604%
1975 Q2	$ 3,612,104,000,000	45,099,868	8.05%	5.30%	2.747%
1975 Q3	$ 3,679,468,700,000	46,483,468	8.30%	8.22%	0.072%
1975 Q4	$ 3,727,699,500,000	48,563,444	8.06%	7.33%	0.737%
1976 Q1	$ 3,800,385,400,000	49,224,378	7.75%	2.88%	4.876%
1976 Q2	$ 3,814,537,600,000	49,839,647	7.77%	5.00%	2.773%
1976 Q3	$ 3,827,897,400,000	50,237,968	7.73%	6.35%	1.381%
1976 Q4	$ 3,867,863,300,000	50,467,427	7.19%	5.56%	1.634%
1977 Q1	$ 3,924,585,500,000	51,721,475	7.35%	8.22%	-0.866%
1977 Q2	$ 3,990,931,100,000	52,240,217	7.37%	6.04%	1.330%
1977 Q3	$ 4,046,860,800,000	53,567,004	7.36%	5.29%	2.067%
1977 Q4	$ 4,038,709,100,000	55,143,265	7.60%	6.53%	1.071%
1978 Q1	$ 4,066,560,700,000	57,594,057	8.01%	7.06%	0.947%
1978 Q2	$ 4,196,987,700,000	59,276,731	8.32%	10.09%	-1.775%
1978 Q3	$ 4,229,368,100,000	61,409,740	8.49%	9.23%	-0.741%
1978 Q4	$ 4,279,183,900,000	62,139,749	8.82%	8.42%	0.399%
1979 Q1	$ 4,280,542,500,000	66,290,739	9.11%	11.78%	-2.675%
1979 Q2	$ 4,284,505,200,000	64,167,862	9.11%	13.16%	-4.048%
1979 Q3	$ 4,310,771,700,000	68,426,682	9.10%	12.19%	-3.085%
1979 Q4	$ 4,318,810,200,000	68,040,241	10.45%	13.44%	-2.994%

DATE	GDP ($1990)	ENPLANE	TNOTES	INF	REALRATE
1980 Q1	$ 4,337,151,500,000	67,047,044	11.99%	16.64%	-4.658%
1980 Q2	$ 4,225,971,500,000	66,731,312	10.48%	11.99%	-1.508%
1980 Q3	$ 4,226,990,500,000	63,703,064	10.95%	6.79%	4.165%
1980 Q4	$ 4,311,903,900,000	63,150,955	12.42%	11.92%	0.504%
1981 Q1	$ 4,370,777,200,000	61,947,935	12.96%	10.19%	2.775%
1981 Q2	$ 4,352,549,100,000	64,412,328	13.75%	8.58%	5.172%
1981 Q3	$ 4,375,305,900,000	62,243,631	14.85%	11.49%	3.355%
1981 Q4	$ 4,305,790,100,000	63,292,123	14.09%	4.30%	9.790%
1982 Q1	$ 4,252,577,700,000	61,601,977	14.29%	2.55%	11.743%
1982 Q2	$ 4,269,560,400,000	64,551,936	13.93%	9.71%	4.215%
1982 Q3	$ 4,250,653,000,000	64,165,557	13.12%	2.89%	10.230%
1982 Q4	$ 4,256,540,300,000	64,902,790	10.67%	0.00%	10.667%
1983 Q1	$ 4,283,599,400,000	69,048,844	10.56%	1.64%	8.926%
1983 Q2	$ 4,400,213,900,000	69,181,265	10.54%	5.30%	5.243%
1983 Q3	$ 4,465,767,000,000	68,555,204	11.63%	4.02%	7.603%
1983 Q4	$ 4,542,415,600,000	69,257,880	11.69%	3.98%	7.703%
1984 Q1	$ 4,630,046,200,000	69,749,519	11.94%	5.92%	6.026%
1984 Q2	$ 4,691,750,000,000	72,145,916	13.20%	3.11%	10.090%
1984 Q3	$ 4,717,110,800,000	74,457,693	12.87%	3.86%	9.009%
1984 Q4	$ 4,748,585,400,000	79,196,690	11.74%	3.06%	8.687%
1985 Q1	$ 4,779,833,500,000	79,908,389	11.58%	4.93%	6.654%
1985 Q2	$ 4,817,195,400,000	82,751,769	10.81%	2.62%	8.192%
1985 Q3	$ 4,878,559,500,000	83,051,958	10.34%	2.23%	8.104%
1985 Q4	$ 4,906,297,900,000	83,789,684	9.76%	5.18%	4.580%
1986 Q1	$ 4,970,832,100,000	85,278,462	8.56%	-1.46%	10.018%
1986 Q2	$ 4,967,662,000,000	87,905,122	7.60%	1.10%	6.503%
1986 Q3	$ 4,995,853,300,000	91,811,015	7.31%	2.19%	5.113%
1986 Q4	$ 5,012,269,900,000	91,263,326	7.26%	2.91%	4.354%
1987 Q1	$ 5,049,518,600,000	93,461,081	7.19%	5.42%	1.778%
1987 Q2	$ 5,112,128,100,000	95,677,264	8.34%	4.63%	3.713%
1987 Q3	$ 5,161,943,900,000	95,934,691	8.88%	4.23%	4.651%
1987 Q4	$ 5,236,894,200,000	93,983,532	9.12%	3.14%	5.987%
1988 Q1	$ 5,270,633,100,000	94,489,487	8.42%	3.11%	5.305%
1988 Q2	$ 5,326,676,000,000	93,733,294	8.91%	5.15%	3.764%
1988 Q3	$ 5,360,301,700,000	95,373,838	9.10%	5.08%	4.020%
1988 Q4	$ 5,411,476,200,000	96,765,560	8.96%	4.01%	4.943%
1989 Q1	$ 5,454,385,800,000	94,156,986	9.21%	4.97%	4.240%
1989 Q2	$ 5,478,614,400,000	92,904,144	8.77%	5.89%	2.886%
1989 Q3	$ 5,478,614,400,000	94,840,462	8.11%	2.58%	5.528%
1989 Q4	$ 5,498,654,000,000	96,588,322	7.91%	4.80%	3.103%

DATE	GDP ($1990)	ENPLANE	TNOTES	INF	REALRATE
1990 Q1	$ 5,537,261,300,000	96,769,500	8.42%	7.28%	1.145%
1990 Q2	$ 5,550,734,200,000	95,789,888	8.68%	4.04%	4.636%
1990 Q3	$ 5,527,977,400,000	96,297,476	8.70%	8.00%	0.703%
1990 Q4	$ 5,472,727,100,000	96,380,535	8.40%	5.13%	3.268%
1991 Q1	$ 5,430,723,200,000	93,270,629	8.02%	2.08%	5.932%
1991 Q2	$ 5,453,819,700,000	93,282,437	8.13%	2.96%	5.167%
1991 Q3	$ 5,470,462,700,000	95,882,123	7.94%	3.24%	4.705%
1991 Q4	$ 5,478,048,300,000	97,669,687	7.35%	3.50%	3.846%
1992 Q1	$ 5,517,901,000,000	96,971,529	7.30%	2.60%	4.700%
1992 Q2	$ 5,539,072,800,000	96,012,283	7.38%	3.16%	4.216%
1992 Q3	$ 5,585,831,800,000	105,952,981	6.62%	2.57%	4.051%
1992 Q4	$ 5,738,223,100,000	100,083,109	6.74%	3.40%	3.344%
1993 Q1	$ 5,749,431,600,000	98,262,090	6.28%	3.09%	3.190%
1993 Q2	$ 5,780,226,900,000	99,145,322	5.99%	2.51%	3.481%
1993 Q3	$ 5,818,721,000,000	98,015,831	5.62%	1.94%	3.678%
1993 Q4	$ 5,907,710,300,000	103,747,464	5.61%	3.31%	2.299%
1994 Q1	$ 5,956,507,200,000	104,615,097	6.07%	2.46%	3.606%
1994 Q2	$ 6,016,512,700,000	106,379,575	7.08%	2.45%	4.638%
1994 Q3	$ 6,076,404,900,000	104,338,757	7.33%	3.51%	3.822%
1994 Q4	$ 6,152,034,500,000	102,760,280	7.84%	2.14%	5.695%

Table A2 - Observation Data Set for Endogenous Variables

DATE	SOLD	OC	R	C	S	SCRAP
1969 Q1	982,500	59.70%	$41.91	16,068	1,594,900	7,400
1969 Q2	956,600	59.70%	$42.41	16,354	1,603,374	7,880
1969 Q3	937,400	58.15%	$42.47	17,308	1,612,685	7,996
1969 Q4	944,400	58.24%	$42.57	18,348	1,621,264	9,769
1970 Q1	912,800	56.08%	$44.18	20,209	1,628,951	12,522
1970 Q2	906,300	55.36%	$44.60	21,876	1,636,370	14,456
1970 Q3	881,500	53.70%	$45.04	22,097	1,643,164	15,303
1970 Q4	876,800	53.15%	$44.98	22,033	1,649,467	15,730
1971 Q1	870,200	52.58%	$44.64	21,314	1,654,644	16,137
1971 Q2	875,000	52.74%	$44.83	20,409	1,660,609	14,443
1971 Q3	894,000	53.66%	$45.06	19,341	1,666,708	13,242
1971 Q4	916,500	54.69%	$45.32	18,629	1,674,570	10,766
1972 Q1	1,007,500	59.89%	$45.08	19,092	1,683,048	10,615
1972 Q2	1,065,800	63.05%	$45.38	20,769	1,691,827	11,989
1972 Q3	1,070,900	62.90%	$46.07	23,880	1,703,208	12,499
1972 Q4	1,080,500	63.04%	$46.11	26,573	1,714,118	15,663
1973 Q1	1,099,400	63.37%	$45.31	29,852	1,735,716	8,254
1973 Q2	1,129,800	64.27%	$44.88	32,684	1,758,695	9,706
1973 Q3	1,144,200	64.30%	$44.81	34,558	1,780,203	13,050
1973 Q4	1,158,900	64.34%	$44.29	36,745	1,801,378	15,570
1974 Q1	1,176,700	64.67%	$43.89	38,252	1,819,775	19,855
1974 Q2	1,198,900	65.29%	$43.43	39,108	1,836,690	22,193
1974 Q3	1,211,300	65.47%	$42.87	37,662	1,851,680	22,672
1974 Q4	1,197,300	64.11%	$43.25	32,554	1,866,027	18,207
1975 Q1	1,165,100	61.98%	$43.74	26,762	1,879,017	13,772
1975 Q2	1,164,200	61.56%	$43.37	21,856	1,891,341	9,532
1975 Q3	1,203,300	63.28%	$42.81	17,246	1,902,844	5,742
1975 Q4	1,197,500	62.59%	$43.01	13,329	1,914,482	1,690
1976 Q1	1,219,900	63.33%	$43.23	10,938	1,924,841	579
1976 Q2	1,253,800	64.75%	$43.55	8,946	1,935,280	(1,493)
1976 Q3	1,314,200	67.52%	$44.01	8,504	1,946,001	(2,217)
1976 Q4	1,269,200	64.90%	$43.62	8,839	1,957,217	(2,377)
1977 Q1	1,319,600	67.03%	$43.77	9,140	1,967,987	(1,629)
1977 Q2	1,332,900	67.35%	$43.69	9,575	1,978,794	(1,233)
1977 Q3	1,362,400	68.47%	$44.19	9,838	1,989,179	(547)
1977 Q4	1,385,800	69.37%	$44.58	10,111	1,999,487	(197)
1978 Q1	1,393,400	69.57%	$45.43	10,975	2,002,825	7,638
1978 Q2	1,416,200	70.52%	$46.24	12,437	2,007,138	8,123
1978 Q3	1,404,400	69.86%	$47.04	13,142	2,011,270	9,009
1978 Q4	1,415,000	70.19%	$47.72	13,118	2,015,596	8,792
1979 Q1	1,441,700	71.36%	$48.91	13,622	2,020,625	8,593
1979 Q2	1,449,900	71.50%	$49.21	14,533	2,027,063	8,095
1979 Q3	1,447,800	71.17%	$49.82	15,746	2,034,771	8,038
1979 Q4	1,461,300	71.45%	$50.16	16,982	2,044,399	7,354

DATE	SOLD	OC	R	C	S	SCRAP
1980 Q1	1,437,600	70.06%	$50.91	19,110	2,052,890	10,618
1980 Q2	1,403,600	68.11%	$51.04	21,235	2,061,812	12,314
1980 Q3	1,408,900	68.08%	$51.55	21,630	2,070,806	12,636
1980 Q4	1,400,700	67.26%	$51.68	21,602	2,080,321	12,086
1981 Q1	1,405,500	67.31%	$52.65	21,003	2,089,701	11,623
1981 Q2	1,412,900	67.30%	$51.94	20,016	2,099,723	9,993
1981 Q3	1,404,800	66.51%	$51.53	20,190	2,111,681	8,232
1981 Q4	1,374,000	64.68%	$52.71	20,659	2,123,210	9,129
1982 Q1	1,414,700	66.34%	$52.66	21,513	2,133,348	11,375
1982 Q2	1,378,900	64.28%	$52.96	21,741	2,144,207	10,881
1982 Q3	1,374,100	63.75%	$52.80	21,781	2,156,142	9,846
1982 Q4	1,388,800	63.96%	$53.59	21,421	2,168,530	9,033
1983 Q1	1,439,800	65.76%	$53.52	22,057	2,191,101	(514)
1983 Q2	1,434,300	64.75%	$54.36	22,563	2,213,012	652
1983 Q3	1,431,800	64.08%	$55.39	23,258	2,236,181	89
1983 Q4	1,468,300	64.88%	$55.29	24,874	2,262,855	(1,801)
1984 Q1	1,503,200	65.64%	$55.36	26,325	2,289,961	(781)
1984 Q2	1,507,500	65.04%	$55.97	27,433	2,317,944	(550)
1984 Q3	1,520,100	64.84%	$56.67	28,836	2,345,902	878
1984 Q4	1,539,500	64.83%	$57.41	30,675	2,373,265	3,312
1985 Q1	1,555,600	64.80%	$56.99	32,836	2,401,093	5,007
1985 Q2	1,559,100	64.14%	$57.53	34,294	2,429,923	5,464
1985 Q3	1,534,500	62.44%	$57.98	35,670	2,459,005	6,588
1985 Q4	1,545,500	62.14%	$57.61	36,758	2,489,441	6,322
1986 Q1	1,541,600	61.16%	$58.37	38,366	2,517,301	10,505
1986 Q2	1,576,400	61.87%	$58.79	39,156	2,546,296	10,162
1986 Q3	1,623,500	63.11%	$59.14	38,901	2,576,325	8,871
1986 Q4	1,582,200	60.76%	$58.77	38,110	2,605,877	8,559
1987 Q1	1,633,000	61.79%	$61.04	38,919	2,646,402	(1,605)
1987 Q2	1,651,000	61.88%	$60.68	38,771	2,678,810	6,363
1987 Q3	1,690,700	62.70%	$60.56	37,050	2,708,823	7,036
1987 Q4	1,678,400	61.62%	$60.72	34,197	2,734,765	8,254
1988 Q1	1,681,300	61.63%	$60.90	32,354	2,758,833	8,287
1988 Q2	1,731,200	62.21%	$60.63	31,011	2,793,333	(3,489)
1988 Q3	1,760,200	62.70%	$60.35	30,684	2,821,875	2,142
1988 Q4	1,768,500	62.38%	$59.80	30,061	2,843,684	8,253
1989 Q1	1,804,900	62.94%	$60.30	29,822	2,867,974	5,532
1989 Q2	1,828,000	63.34%	$59.73	28,564	2,893,011	3,527
1989 Q3	1,834,000	63.11%	$59.62	26,775	2,924,234	(4,447)
1989 Q4	1,863,800	63.44%	$58.50	25,327	2,950,897	(1,335)

DATE	SOLD	OC	R	C	S	SCRAP
1990 Q1	1,889,000	63.48%	$59.61	25,163	2,971,728	4,332
1990 Q2	1,880,300	62.92%	$58.94	25,692	2,987,708	9,711
1990 Q3	1,865,900	61.93%	$57.56	26,581	3,024,701	(10,411)
1990 Q4	1,857,400	61.15%	$56.46	25,609	3,046,659	3,652
1991 Q1	1,818,100	59.36%	$57.08	23,488	3,061,599	8,547
1991 Q2	1,886,100	61.36%	$57.01	20,306	3,077,905	4,001
1991 Q3	1,880,500	61.07%	$55.67	17,380	3,087,711	7,573
1991 Q4	1,887,200	60.99%	$55.42	14,172	3,096,869	5,014
1992 Q1	1,871,000	60.84%	$56.16	11,209	3,108,029	49
1992 Q2	1,918,000	61.55%	$55.72	8,531	3,117,962	(1,402)
1992 Q3	1,950,100	62.54%	$55.09	7,367	3,125,908	(579)
1992 Q4	1,942,500	62.13%	$54.56	6,994	3,132,930	(28)
1993 Q1	1,965,000	62.50%	$56.62	8,432	3,138,935	2,427
1993 Q2	1,974,500	62.76%	$55.82	8,520	3,149,138	(1,683)
1993 Q3	1,996,300	63.41%	$55.01	7,950	3,155,917	1,172
1993 Q4	2,014,200	63.67%	$54.92	12,707	3,172,341	(3,718)
1994 Q1	2,055,600	64.54%	$56.74	8,397	3,179,774	964
1994 Q2	2,061,500	64.63%	$56.54	7,112	3,193,147	(6,261)
1994 Q3	2,076,800	64.99%	$55.61	8,181	3,202,912	(1,584)
1994 Q4	2,122,000	66.17%	$55.86	10,235	3,211,938	1,208

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