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**CAPITALIZATION RATE, MORTGAGE
INTEREST RATE AND COMMERCIAL
MORTGAGE DEMAND**

You Zhou

Thesis, 2001

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**Capitalization Rate, Mortgage Interest Rate and
Commercial Mortgage Demand**

by

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Submitted to the Department of Urban Studies and Planning in Partial Fulfillment of the
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
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By

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Submitted to the Department of Urban Studies and Planning on August 10, 2001 in partial fulfillment of the requirements of the Degree of Master of Science in Real Estate Development at the Massachusetts Institute of Technology.

ABSTRACT

This thesis examines commercial mortgage demand and its linkage with capitalization rate and commercial mortgage interest rate. Cap rate and mortgage interest rate are found to be underlying driven force of commercial mortgage demand. They affect commercial mortgage demand through their impact upon investor's investment decisions and financing decisions. Commercial mortgage demand increases with cap rate but decreases with mortgage interest rate. Commercial mortgage demand is also related to new construction and existing properties. Commercial mortgage demand reaches peaks during construction booms but hits bottoms during construction busts.

Commercial mortgage demand in the United States, United Kingdom and Japan is analyzed. Research manifests that in these three countries, commercial mortgage demand follows the same rule. Commercial mortgage flow increases with cap rate and new construction but decreases with mortgage rate and stock of space. New construction is the dominant factor for commercial mortgage demand in US and UK market while in Japan, stock of construction is the dominant factor for bank lending flow to real estate industry during the past decade. Commercial mortgage demand in US, UK and Japan is predicted with the mortgage demand model established in this thesis.

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Chapter 1. Introduction

Capitalization rate is the ratio of net operating income to property price. Mortgage interest rate indicates the cost of debt. Commercial mortgage lenders have noticed that the spread of capitalization rate over mortgage interest rate influences mortgage demand. If the spread is thin, then real estate lending activities are either minimal or have a tendency to slow down. However, a greater spread between capitalization rate and mortgage interest rate promotes real estate lending activities. However, people do not know why and how capitalization rate and mortgage interest rate affect commercial mortgage demand. This calls for the inquiry into the relation among these three.

In addition to capitalization rate and mortgage interest rate, commercial mortgage demand is related to new construction because it is a major source of demand for commercial mortgages. New construction is also affected by capitalization rate and mortgage interest rate. It prospers when property price is high and construction cost is low. For constant net operating income, higher property price results from lower capitalization rate. Therefore, lower capitalization rate seems to promote commercial mortgage demand. However, commercial mortgage demand increases with the spread between cap rate and mortgage interest rate and the spread shrinks when cap rate falls. Lower capitalization rate should erode commercial mortgage demand from this perspective. This intriguing analysis suggests the research to uncover the connection among new construction, capitalization rate, mortgage interest rate, and commercial mortgage demand.

Commercial mortgage demand in different countries head different ways at a given time point, but they may subject to the same principle. For instance, commercial mortgage demand in the US and in UK can be affected by same factors such as capitalization rate and mortgage interest rate. If one can establish commercial mortgage demand model for different countries, then he can estimate and predict the trend of commercial mortgage demand in those countries. This model can be very useful for international commercial mortgage lenders who are seeking loan origination opportunities throughout the world.

The objective of this thesis is to study the connection among capitalization rate, mortgage interest rate and commercial mortgage demand. The author will first explain commercial mortgage demand theory, introduce and analyze important factors of mortgage demand such as capitalization rate, mortgage interest rate, new construction and loan to value ratio. Second, the author will estimate and forecast commercial mortgage flow in the United States, United Kingdom and Japan from mortgage demand side. Finally, the author will compare and contrast commercial mortgage demand in the three countries, summarize the analysis results and draw conclusions.

The content of thesis is listed as following:

Chapter 1 Introduction

Chapter 2 Cap rate, mortgage interest rate and commercial mortgage demand

Chapter 3. Cap rate and new construction

Chapter 4 Mortgage interest rate and loan to value ratio

Chapter 5 US commercial mortgage demand estimation and forecast

Chapter 6 UK commercial mortgage demand estimation and forecast

Chapter 7 Japan commercial mortgage demand estimation and forecast

Chapter 8 Conclusions

Chapter 2. Cap rate, mortgage interest rate and commercial mortgage demand

Commercial mortgage flow is the product of interactions between commercial mortgage demand and supply. Borrowers as well as lenders can affect the net flow of commercial mortgages. On the demand side, borrowers finance with debt to obtain higher equity return if the cost of debt is less than the return on real estate investment. On the supply side, lenders determine the price of loans and establish underwriting standards. To simplify the problem, this research will first analyze commercial mortgage demand from the borrower's standpoint, and then model commercial mortgage flow mainly considering mortgage demand side.

2.1 Cap rate, mortgage interest rate and commercial mortgage demand

Commercial mortgage demand first depends on investors' decision to invest. Investors are return driven. They will undertake an investment if the investment provides an equity return that exceeds required return on equity or equity hurdle rate¹. For instance, real estate developers will compare the expected equity return on a project and their equity hurdle rate before starting development. When people refinance, they increase their return on equity by taking advantage of lower mortgage interest rate. Thus, inequality $R_E > R_H$ must hold if investors decide to undertake an investment, where R_E is the equity return rate and R_H is equity hurdle rate.

Commercial mortgage demand further rests on investor's decision to borrow. Investors can finance a project with equity, debt or a combination of two. Investors will use debt

¹ William C. Handorf, Sachlis J Minor, *Hurdle rate and investment analysis*, Real estate review, New York, Winter 1994.

only if the cost of debt is less than total return on investment. According to corporate finance theory, total return on investment is the weighted average cost of capital.

$$R = \frac{L}{V}(1-t) * mr + \left(1 - \frac{L}{V}\right) * R_E \quad (2.1)$$

Where

R = total return on investment;

t = tax rate;

mr = mortgage interest rate;

R_E = return on equity;

$\frac{L}{V}$ = loan to value ratio;

Return on equity can be expressed as $R_E = \frac{R - \frac{L}{V} * (1-t) * mr}{1 - \frac{L}{V}}$. It is apparent that when

total return R is greater than mortgage interest rate mr , equity return R_E increases with loan to value ratio $\frac{L}{V}$ and the ideal loan to value ratio is 1. This explains why investors leverage up. Here risks associated with leverage are not considered because there is no agreement among economist about how to incorporate risks. If risks related to leverage are taken into account, then the ideal loan to value ratio is much less than 1.

Commercial mortgage demand therefore is a function of the equity return rate and equity hurdle rate.

$$MD = F(R_E - R_H) \quad (2.2)$$

Where

MD = mortgage demand;

R_E = equity return;

R_H = equity hurdle rate;

Equation (2.2) indicates that commercial mortgage demand rises with equity return but falls with equity hurdle rate. Equity hurdle rate in equation (2.2) can be described as

$$R_H = tr + spread \quad (2.3)$$

Where

R_H = equity hurdle rate;

tr = treasury rate whose time to maturity is comparable to the term of equity investment;

spread = difference between equity hurdle rate and treasury rate;

The spread in equation (2.3) is determined by real estate investment specific risks.

So far, no connection between cap rate and commercial mortgage demand can be seen. However, Equation (2.1) and (2.2) do imply a relationship between the cap rate and the commercial mortgage demand. To understand it, one first need to know the linkage between cap rate and total return on investment.

Cap rate is defined as the ratio of net operating income to property price. It is related to the direct capitalization method. Return on investment is often obtained by using the discounted cash flow method (DCF). According to real estate finance theory, the relationship of cap rate and total return on investment can be expressed as the following equation.

$$R = cap + g \quad (2.4)$$

Where

R = total return on investment;

cap = cap rate;

g = income growth rate;

Plugging equation (2.3) back into the formula of equity return, one will get the following equation:

$$R_E = \frac{cap + g - \frac{L}{V}(1-t) * mr}{1 - \frac{L}{V}} = \frac{\frac{L}{V}(1-t) * (cap + g - mr) + (1 - \frac{L}{V} + \frac{L}{V} * t) * (cap + g)}{1 - \frac{L}{V}}$$

Lenders usually use stabilized net operating income and cap rate to estimate property value and to decide the loan amount. If the stabilized net operating income is used, then

income growth rate g can be ignored. In such situations, total return roughly equals the cap rate. Therefore, the equity return equation can be rewritten as

$$R_E = \frac{cap - \frac{L}{V}(1-t) * mr}{1 - \frac{L}{V}} = \frac{\frac{L}{V}(1-t) * (cap - mr) + (1 - \frac{L}{V} + \frac{L}{V} * t) * cap}{1 - \frac{L}{V}}$$

The equity return equation above demonstrates that the spread of cap rate over the mortgage interest rate affects the equity return. Everything else remaining constant, the wider the spread, the higher the equity return. Since commercial mortgage demand is positively correlated with equity return, mortgage demand in turn moves with the spread of cap rate over mortgage interest rate. The wider the spread, the greater the demand for commercial mortgage. This is consistent with the observations of commercial mortgage lenders.

In sum, cap rate and mortgage interest rate can influence the demand for commercial mortgage through their impact on equity return. Cap rate and mortgage interest rate are indicators of real estate market and capital market respectively. Commercial mortgage demand reflects the interaction of real estate market and capital market.

2.2 Commercial mortgage demand model

The endogenous variable of the commercial mortgage demand equation is the net commercial mortgage flow. Net commercial mortgage flow is the sum of mortgage origination and retirement. It can be affected by mortgage demand and mortgage supply. Here, only mortgage demand side has been taken into consideration. Exogenous variables of commercial mortgage demand equation include variables that can drive commercial mortgage demand and variables that can explain the distribution of commercial mortgage flow.

Cap rate and mortgage interest rate are factors that influence commercial mortgage demand. They affect commercial mortgage demand through their impact on investors' investment and financing decisions. They should be incorporated into commercial mortgage demand model.

To quantify commercial mortgage flow, one need to be aware of the use of commercial mortgages and capture those factors that can influence mortgage origination and retirement, especially factors that can influence mortgage origination.

Each year, newly originated commercial mortgages flow into two groups of commercial real estate properties. One is newly built property. Commercial mortgages are used to take out construction loans. Another group is the existing property. Commercial mortgages are used as funds of refinancing and investing.

The amount of commercial mortgages used to take out construction loans is proportional to the volume of new construction completed.

$$M_1 = \left(\frac{L}{V} \right) * Cons \quad (2.5)$$

Where

M_1 = commercial mortgages to take out construction loans;

$\frac{L}{V}$ = loan to value ratio of newly built properties;

$Cons$ = value of new construction completed;

Factors that affect commercial mortgages on new constructions include construction volume and the leverage condition of properties. Therefore, Cap rate and mortgage interest rate influence commercial mortgage demand through their impact on new construction of income properties. Real estate developers usually conduct market studies and financial feasibility analysis and must obtain permanent loan commitment subject to construction financing before they start development. Cap rate is an indicator of the real

estate market, and mortgage interest rate measures the cost of debt. They are important factors developers will encounter when making investment and financing decisions.

It is difficult to quantify mortgages used to refinance and invest. However, capturing important factors affecting mortgage flows into existing properties is not as difficult. For instance, it is safe to say that the stock of income properties is relevant to the flow of commercial mortgages into existing properties.

Demand for mortgages on existing properties is subject to the rule described in Equation (2.2). Cap rate and mortgage interest rate are responsible for the demand of mortgages as a source of investment. Demand for mortgages used to refinance can also be attributed to the change of cap rate and mortgage interest rate. Lower mortgage interest rate makes refinancing possible. Meanwhile, for a given income, lower cap rate results in a higher property price, which in turn qualifies owner of income properties for higher principals of loans. The net flow of commercial mortgages will not be affected by refinancing decisions unless owners of income properties replace existing loans with larger new loans. This may happen when mortgage interest rate falls and property price rises.

Up until now, five variables are thought to be important for constructing a commercial mortgage demand model. They are: cap rate, mortgage interest rate, new construction, loan to value ratio and stock of income properties. As discussed above, cap rate and mortgage interest rate are inherent elements of commercial mortgage demand. They move commercial mortgage flow up and down from the demand side. New construction, loan to value ratio, and stock of existing income properties explain the distribution of commercial mortgage flow. They are variables used to quantify the origination of commercial mortgage. Put these five variables together, one can construct a commercial mortgage demand model. Mortgage demand is the function of these five variables.

$$MORT_d = F(Cap, mr, cons, LTV, stock) \quad (2.6)$$

Where

$MORT_d$ = mortgage demand;

Cap= cap rate;
mr = mortgage interest rate;
 cons= new construction;
 LTV= loan to value ratio;
 Stock= stock of income property;

One can predict the sign of each variable in the commercial mortgage demand equation. It is easy to predict the sign of the cap rate, mortgage interest rate and new construction from the mortgage demand side. The stock value used in this thesis is constructed. The stock value in year *t* is the sum of base value and the new construction from the year *j* to the year *t*. Base value of stock is calculated by adding all the constructions from a starting point to the year *j*-1. The stock value used in this thesis is the “book” value and it measures what it cost to build. It seems logical to assume that stock of existing income properties has a positive sign. The underlying rationale is that the greater the stock of existing properties, the more demand there will be for commercial mortgages. In fact, the stock of existing properties is responsible for both old loan retirement and part of new loan origination. Whether the stock have a positive or negative sign depends on which part has greater impact. If the value of retired loans is greater than the value of new loans flow into existing properties, then the sign of stock shall be negative. Otherwise, stock shall have a positive sign.

Estimating the sign of loan to value ratio is a little complicated. Solely from the perspective of mortgage demand, loan to value ratio should have a positive sign. The derivative of equity return to loan to value ratio equals $\frac{R - (1 - t) * mr}{\left(1 - \frac{L}{V}\right)^2}$. As long as return

R exceeds mortgage interest rate *mr*, the derivative will be positive. This indicates that equity return rises with loan to value ratio. Because mortgage demand also increases with equity return, the sign of the loan to value ratio should be positive. Similar evidence can be found in Equation (2.5), which shows that Mortgage flow into new constructions

correlates positively with the loan to value ratio. In short, the sign of the loan to value ratio should be positive from borrower's standpoint.

However, loan to value ratio is not determined by borrowers, but by lenders. Even though borrowers want to take the most advantage of debt, the loan to value ratio that lenders consider appropriate may be much less than what borrowers had expected. As a consequence, the sign of loan to value ratio may turn out to be negative if lenders exert impact upon loan to value ratio.

In general, the sign of each variable is:

1. cap rate (+)
2. mortgage interest rate (-)
3. new construction (+)
4. stock of existing properties(+/-)
5. loan to value ratio(+/-)

Notice that tax rate can influence return on investment but tax rate is not built into the commercial mortgage flow model. Tax rate was ignored because it does not change as frequently as other variables such as mortgage interest rate. In USA, for example, the most recent tax law change took place in 1976,1981 and 1986. In addition, real estate investment decisions can be affected by tax benefits, but tax benefits alone are not enough motivation for real estate investment. Furthermore, the change of tax treatment of real estate investment can be reflected by the adjustment of cap rate. According to the research conducted by Nourse, Hough O ², the decrease of cap rate because of tax law changes in 1974 and 1981 were not significant. Possible reason for this fact is that investors most affected by the tax changes are not dominant players in the real estate market.

² Nourse Hough O., *The "Cap Rate", 1966-1984: A Test of the Impact of Income Tax Changes on Income Property*, Land Economics, Madison, May 1987

Income growth rate g was also ignored because lenders usually use stabilized net operating income and cap rate to calculate property price. Income growth rate is assumed zero under such circumstances. Lenders use cap rate, rather than total return in their underwriting process. As component of total return, income growth rate is not as important as cap rate at least from mortgage lenders' perspective.

2.3 Source of error

In this chapter, commercial mortgage demand model is addressed. This model is far from perfect. Systematic errors mainly come from the following sources.

1. Mortgage supply side

Mortgage supply side as well as mortgage demand side have impact upon commercial mortgage flow. For instance, the supply of capital available to financial intermediaries determines how much capital is available to real estate investors; in turn, a financial institution's opportunity cost of capital is the basic component of mortgage price. Both of them can influence the flow of commercial mortgages but they are not incorporated into the commercial mortgage flow model, resulting in systematic errors.

2. Data

Imperfect data is another significant source of error. For instance, the US cap rate data is from NCREIF. NCREIF property price is not market price, but appraised price.

Consequently, NCREIF cap rate lags true cap rate because appraisers look backward when they estimate the property values. Another example might be the data of stock space. It is constructed by adding all the constructions starting from a given year without considering depreciation. This stock value is the "book value" and it measures what cost to build. What should matter to loan demand is what it is worth or the market value of stock. This would be something like the "book value" times a price index such as is produced by NCREIF in US.

3. Limited independent variables

Limited variables were incorporated into the commercial mortgage demand model. Other factors that may have impact on commercial mortgage flows were ignored. For instance, inflation rate, treasury rate, capital consumption per capita, investor's expectation of economy development, and performance of comparable investment mechanisms other than real estate were not included in the analysis. Ignored factors might be responsible for some of the systematic error.

4. Inability to measure risk

The inability to measure risk is a big source of errors. For instance, there is no effective way to incorporate real estate specific risk into commercial mortgage demand model. In addition, the risk associated with debt financing is hard to quantify, therefore it is difficult to estimate the optimum loan to value ratio from borrowers' perspective.

Chapter 3. Cap rate and new construction

The objective of this chapter is to introduce two variables in the model for commercial mortgage demand: the capitalization rate and new construction. Because both the capitalization rate and new construction are related to the real estate market, they are combined in this chapter.

3.1 Cap rate

Introduction

By definition, the cap rate is the ratio of net operating income to property value. The cap rate is directly correlated to commercial mortgage lending because mortgage lenders usually utilize cap rate and stabilized net operating income to calculate property price. Once property prices are calculated, mortgage lenders can determine the loan amount. Cap rate influences commercial mortgage demand by influencing the return on equity. As discussed in chapter 2, the spread of cap rate over mortgage interest rate drives commercial mortgage demand up and down.

Elements of cap rate

Cap rate provides an indicator of the real estate market. Factors that affect net operating income and property value affect the cap rate. According to Wilson David Jr.¹, factors which influence the cap rate can be divided into two groups. The first group is property specific factors; the second group is economy specific factors.

Property specific factors include:

- future rental growth and capital appreciation,
- strength of lessee,
- covenants and tenant's ability to pay,

¹ Wilson, David Jr., *Elements of the capitalization rate*, The Canadian Appraiser, Winnipeg, Fall 1991.

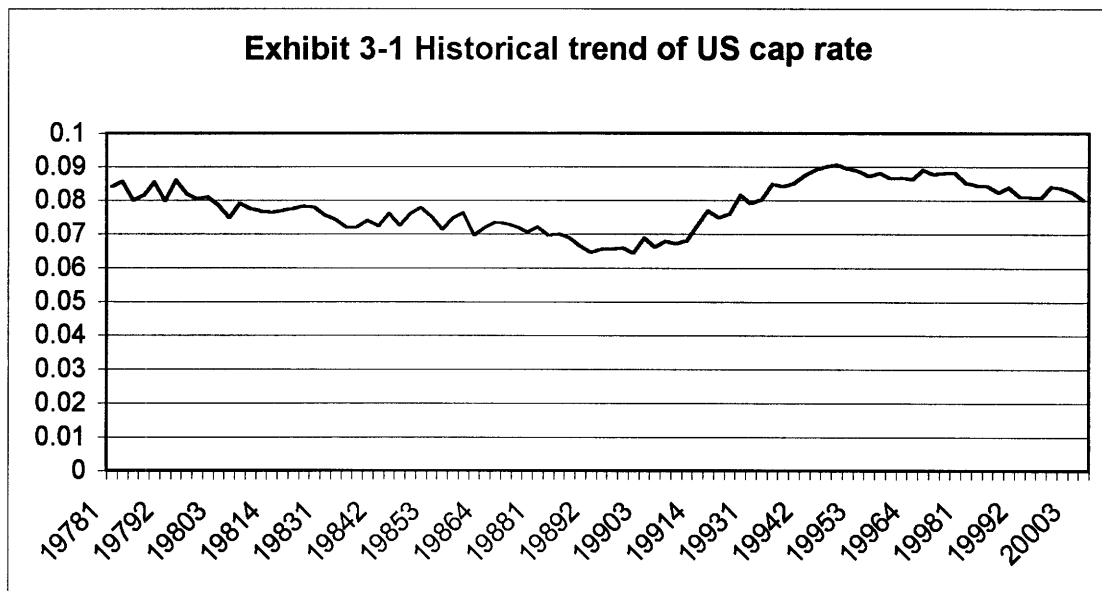
- rent review pattern,
- age-life of improvement and income stream,
- ease of management and size of the investment,
- liquidity of the investment,
- ratio of land value to total value and taxation advantages.

Economy specific factors include

- current inflation rate,
- general level of interest rate,
- the economic health of the area, region and country
- general level of investors' confidence.

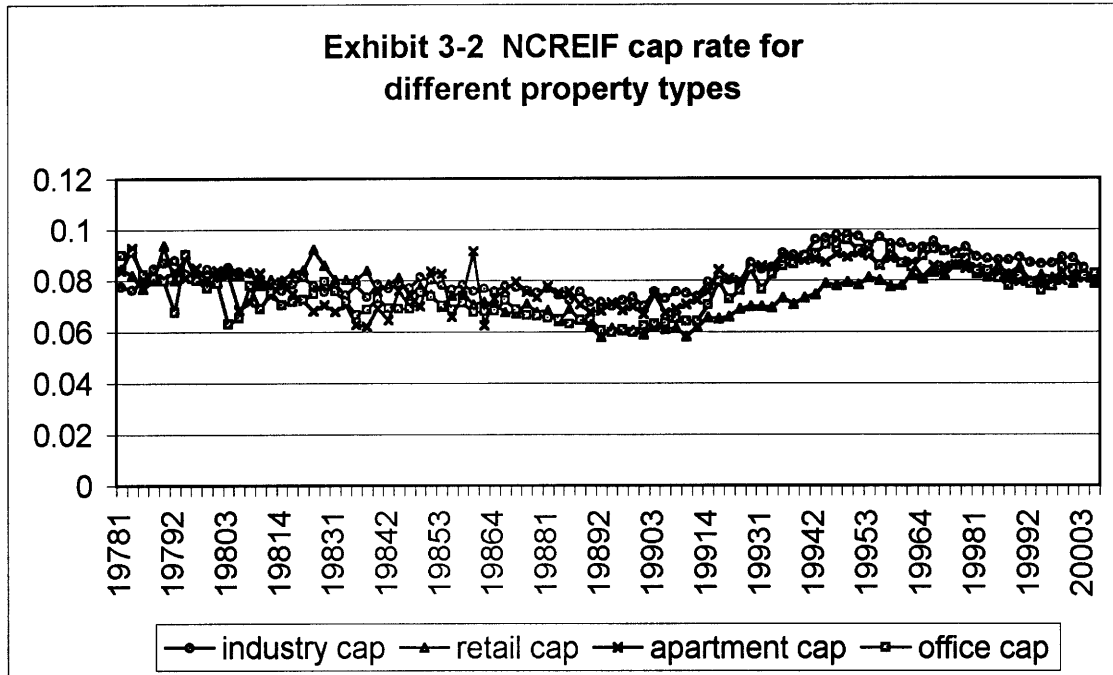
Historical trend of cap rate in the United States

Exhibit 3-1 depicts cap rate in the US. It is un-weighted average of cap rates for office, industry, retail and apartment buildings in the United States from 1978 to 1998. The cap rate in exhibit 3-1 averaged at 0.076 with a standard deviation of 0.025. The data is obtained from the National Council of Real Estate Investment Fiduciary (NCREIF).



Cap rate for different property types

Cap rates for different property types are similar. Exhibit 3-2 depicts NCREIF quarterly cap rates for four different property types from 1978 to 2000.



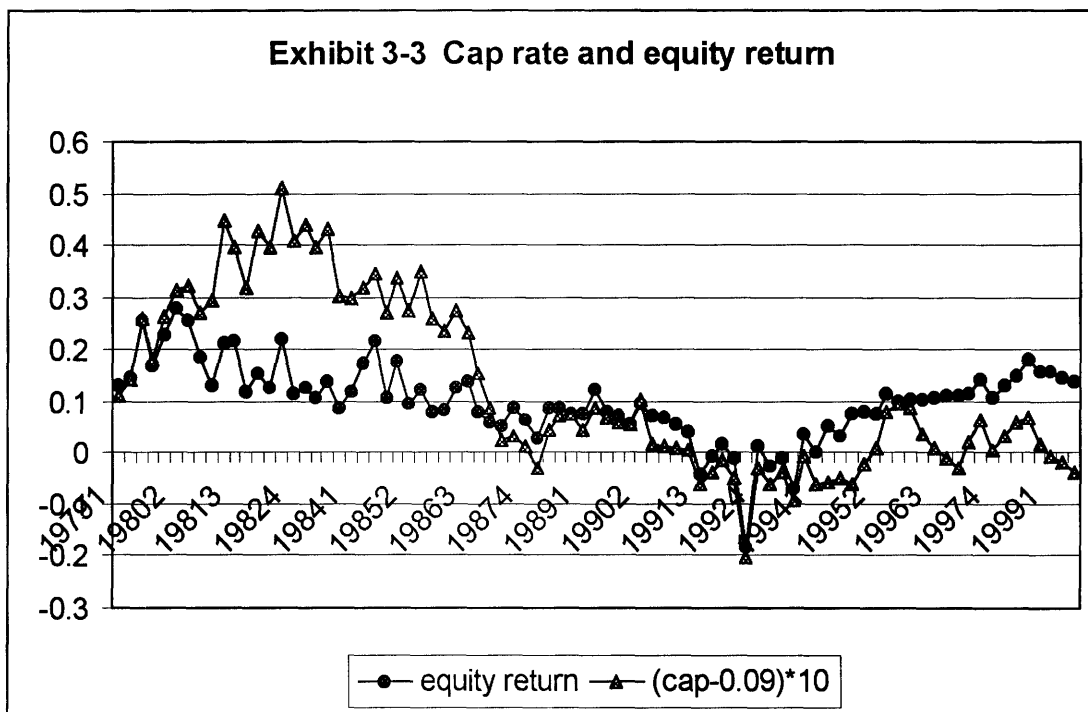
The average cap rate and its standard deviation for each property type are summarized in Table 3-1. The cap rates for industrial properties have the highest average and the lowest volatility. The average cap rates for other types of properties are similar. Office cap rates have the highest standard deviation while industrial cap rates have the lowest standard deviation.

Table 3-1 Average and standard deviation of NCREIF cap rates

	Industry cap rate	Retail cap rate	Apartment cap rate	Office cap rate
Average	0.08227388	0.075656	0.078355	0.076213
Standard deviation	0.00752716	0.008337	0.007713	0.009907

Cap rate and equity return

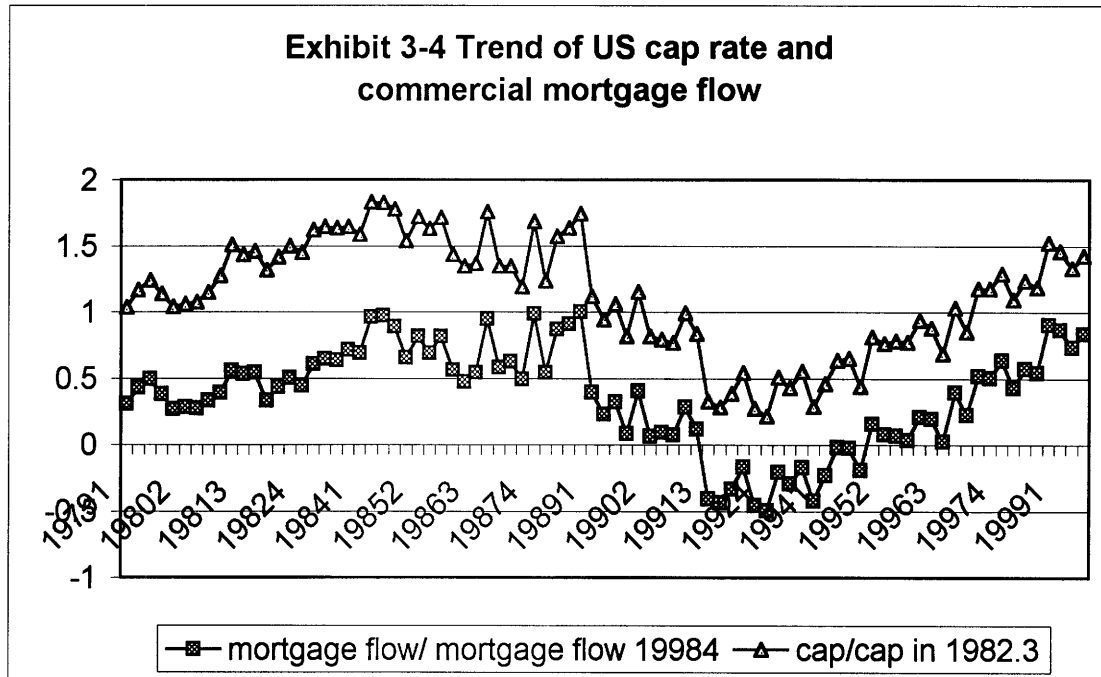
As previously discussed in Chapter 2, the cap rate is a component of return on equity. Cap rates move in the same direction as the return on equity. Exhibit 3-3 depicts the trend of cap rates and return on equity in the United States over the same period. The data of equity return was obtained from NCREIF, while cap rates for leveraged properties were calculated. Exhibit 3-3 shows that equity return roughly increases with cap rate.



Cap rate, mortgage interest rate and commercial mortgage flow

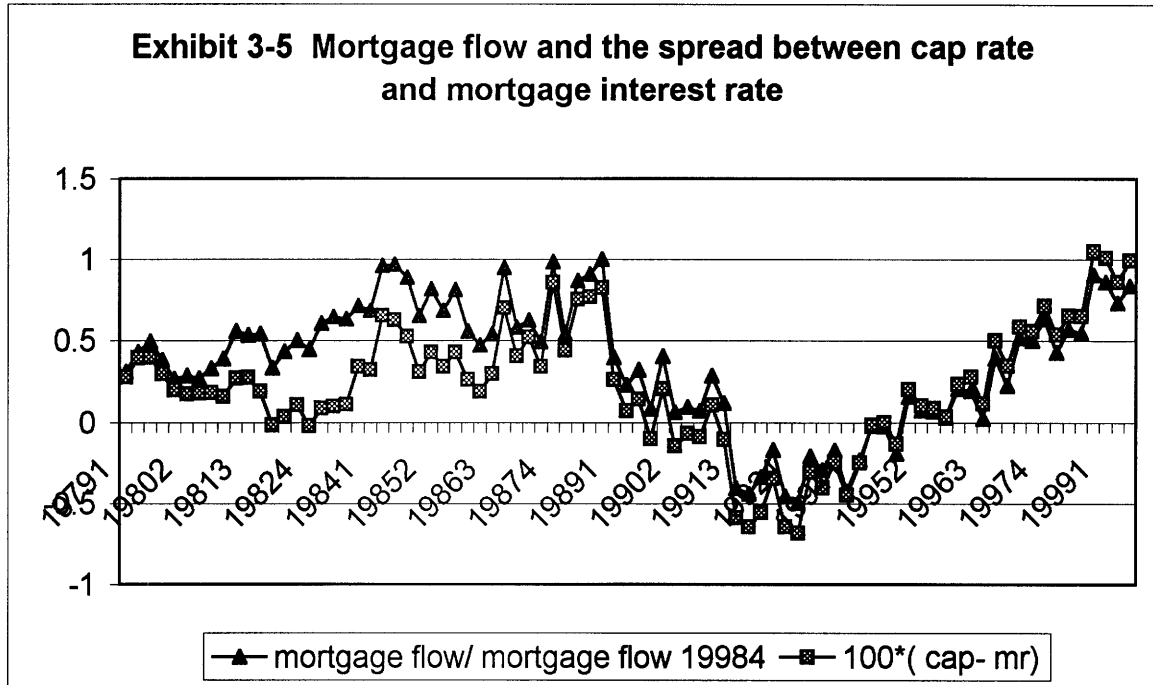
Exhibit 3-4 depicts the trend of commercial mortgage flow and cap rates in the United States. In Exhibit 3-4, commercial mortgage flow lags cap rate by one year because new commercial mortgage origination often lags mortgage commitment by a one-year period. Assuming construction takes one year to complete, mortgages originated to take out construction loans therefore lag commitment for one year.

In Exhibit 3-4, mortgage flow changes in the same direction as the cap rate, reaching its lowest in 1993. Commercial mortgage flow has been negative from 1991 to 1994. However, it has increased quickly since 1995.



note: mortgage flow 1984 means mortgage flow in 1998 fourth quarter.

Exhibit 3-5 depicts the trend of commercial mortgage flow in the United States and the spread between the cap rate and the mortgage interest rate. Commercial mortgage flow data in Exhibit 3-4 lags cap rate and mortgage interest rate data for one year to account for the construction period. It shows that commercial mortgage flow in the United States fluctuates with the change in cap rate over mortgage interest rate. In years 1992 and 1993, both the spread and commercial mortgage flow in the United States fell to their lowest points. Between 1987 and 1988, commercial mortgage flow and the spread reached a peak. In recent years, commercial mortgage flow as well as the spread between the cap rate and mortgage interest rates climbed gradually. The historical trend of commercial mortgage flow, cap rates and mortgage interest rates is consistent with discussions in Chapter 2.



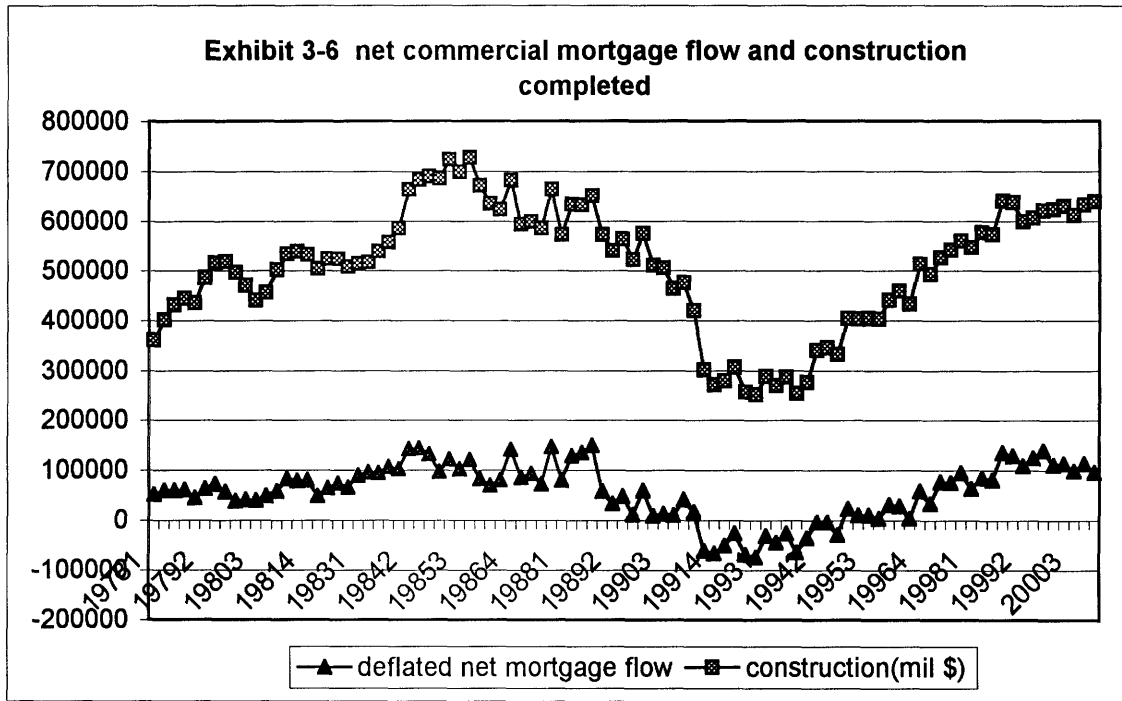
3.2 New construction

Introduction

New construction of income properties is a determining factor of the demand for commercial mortgages. Commercial mortgage flow is highly correlated with new construction. For instance, in the United States, the correlation of commercial mortgage flow and new construction is 76.7%. Exhibit 3-6 depicts the trend of new construction completed and commercial mortgage flow in the United States. Notice that construction value in exhibit 3-6 is deflated value.

Net commercial mortgage flow correlates positively with new construction. New construction fell from late 1980s to early 1990s and dropped to the bottom in 1994. Commercial mortgage flow also reached the bottom in 1994. Notice that in years 1983 to 1988, commercial mortgage flow increased at a greater pace than new construction. There is an oversupply of commercial mortgages during these years. Oversupply of commercial mortgages may be responsible for the overbuilding in the 1980s. After 1995,

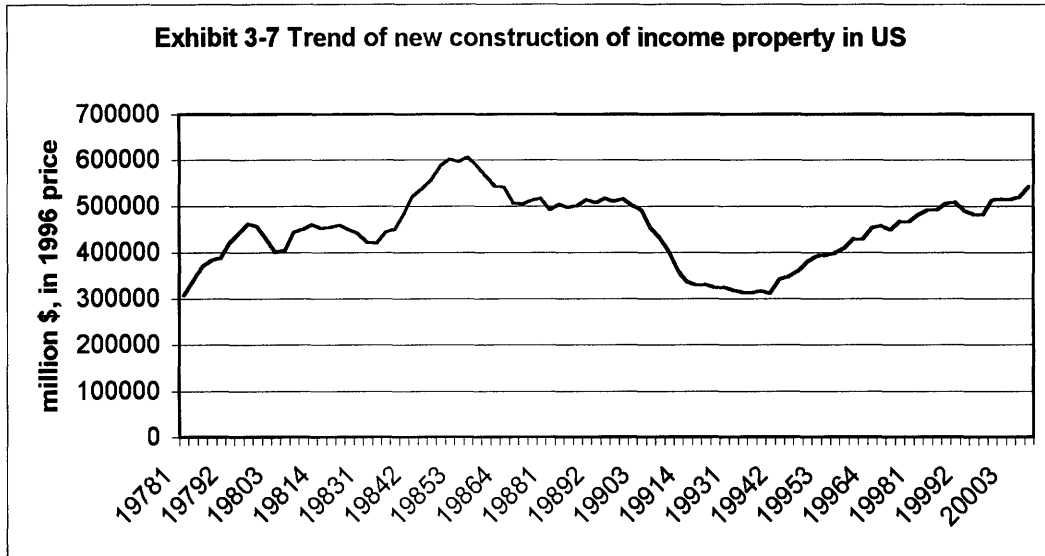
both new construction and commercial mortgage flow picked up, but commercial mortgage flow increases at a faster speed than new construction.



Note: construction value in exhibit 3-6 is deflated value.

Historical trend of new construction in the US

Exhibit 3-7 depicts new construction of income properties completed in the United States from the first quarter of 1978 to the first quarter of 2001. The average new construction of income properties completed is 451768 million, with a standard deviation of 75577 million. New construction value in exhibit 3-7 is deflated value.



Note: new construction value in exhibit 3-7 is deflated value.

New construction, cap rate and mortgage interest rate

Cap rates and mortgage interest rates can affect new construction. Like other investors, real estate developers are return motivated. They will build a project only when the return on the investment can justify the risks they take. In other words, they will start new construction if the expected return on equity exceeds their equity hurdle rate. Cap rates and mortgage interest rates are important elements of equity investment return. They are factors real estate developers will consider before they undertake a project. Moreover, developers will finance new construction with debt if they are rewarded with a higher return on equity. Mortgage interest rates can influence their financial decision.

Exhibit 3-8 presents the spread between cap rates and mortgage interest rate and new construction of income property completed in the United States. The data indicates that the level of new construction completed is positively correlated with the spread between the cap rate and the mortgage interest rate.

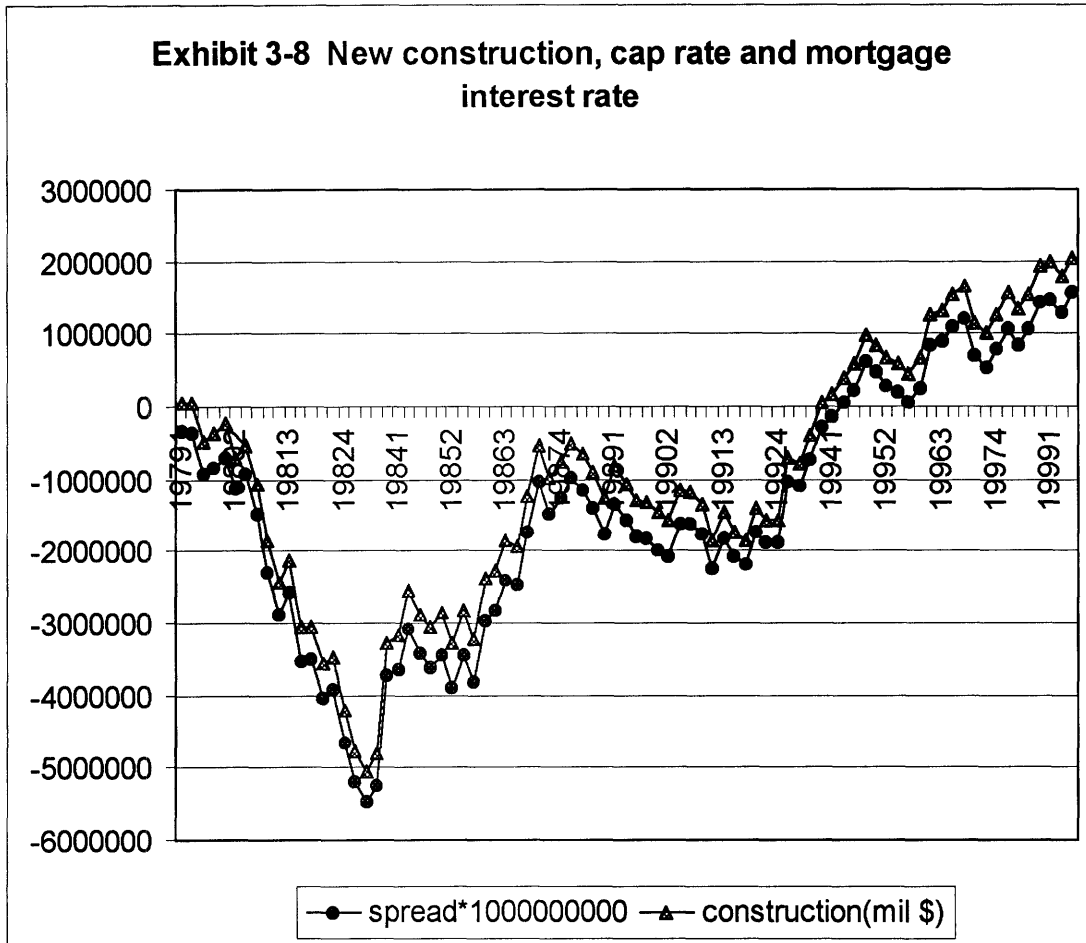
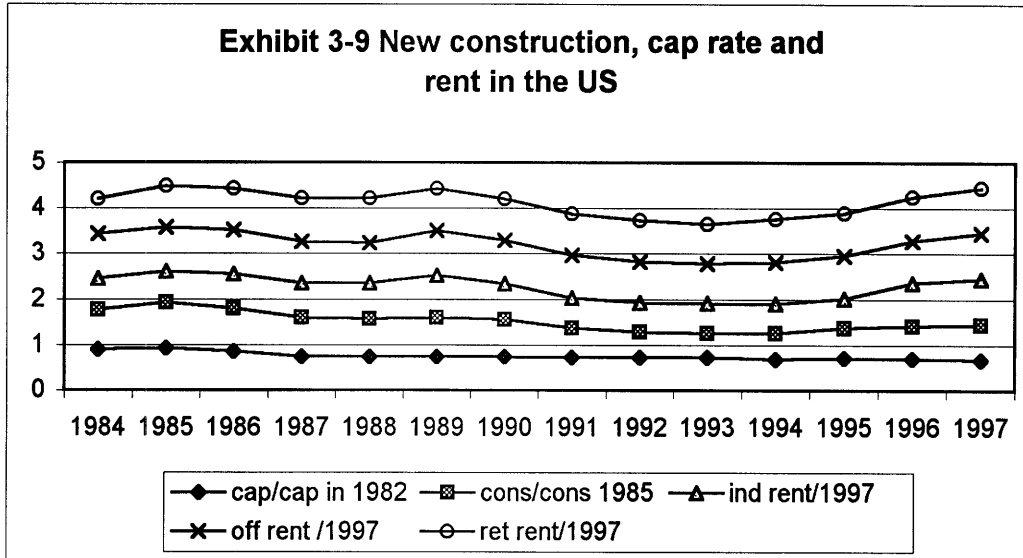


Exhibit 3-8 note: spread means (cap-mr), the difference between cap rate and mortgage interest rate.

New construction, cap rate and rents

Exhibit 3-9 presents the trend of new construction completed, cap rate and rents from 1984 to 1997 in the United States. Listed below are rents for office, retail and industrial properties. In order to account for the construction time, in exhibit 3-9, the data on new construction completed lags one year behind. Exhibit 3-9 indicates that new construction rises and falls with cap rate and rents. In other words, the boom in construction will occur when both property rents and cap rate are high. New construction slows down when rents and cap rate are low.



New construction, cap rate and commercial mortgage flow

The demand for commercial mortgages positively correlates with new construction and cap rates, but is negatively correlated with mortgage interest rates. When cap rates are high and mortgage interest rates are low, demand for commercial mortgages rises. When cap rates are high, with given net operating income, property prices are low. As expected, there is a decline in new construction when property prices are low. Under such circumstances, the flow of commercial mortgages should decrease as a result of the decline in new construction. This contradicts the original statement that when cap rates are high, commercial mortgage demand should pick up. Consequently, this raises the question of “when does commercial mortgage flow reach a peak? Does it reach a peak during the construction boom or during the construction bust?” One can ask a similar question of “which factor is more significant to commercial mortgage flow, new construction or the spread between cap rates and mortgage interest rates?”

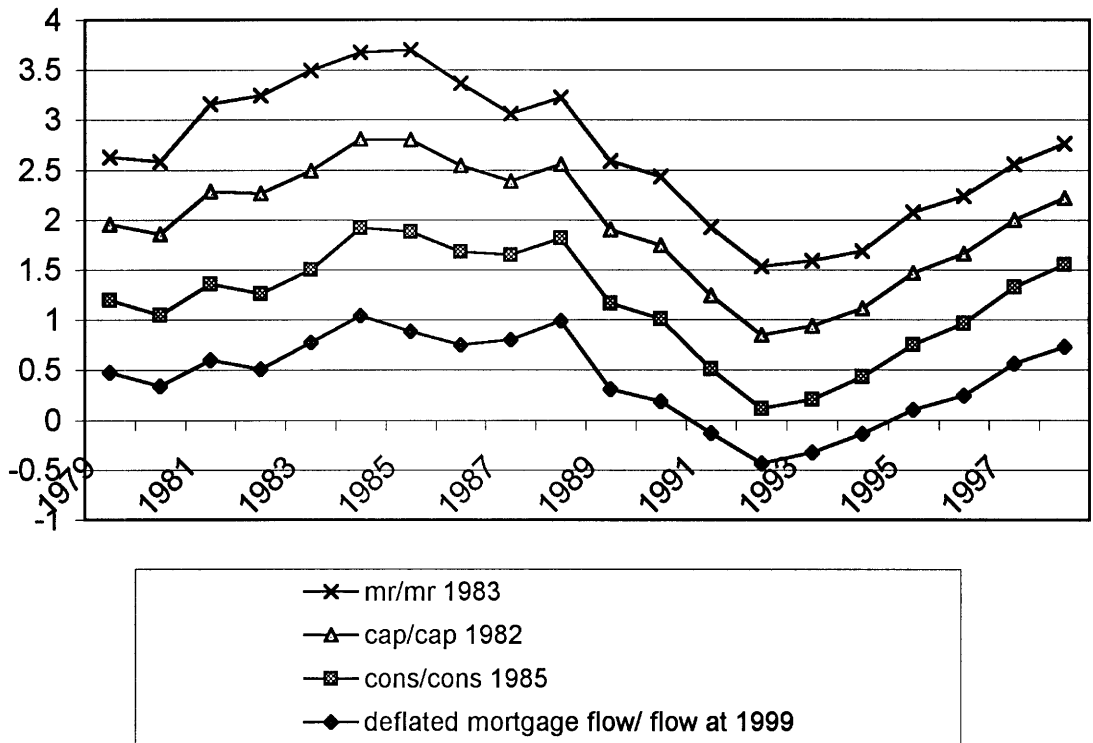
The change in cap rates and mortgage interest rates can explain the change of commercial mortgage demand. However, most newly originated commercial mortgages flow into newly built income properties as a take out of construction loans. Therefore, new construction is the dominant factor for commercial mortgage new origination. It is a more significant factor of commercial mortgage flow than the spread between cap rate and

mortgage interest rate. As a result, commercial mortgage flow should reach a peak during a construction boom, Even though the cost of debt is not the cheapest and cap rate is not the highest during this period. If the market is efficient, then construction will slow down when demand for new space falls. Meanwhile, property price falls with the decline in demand for new space. As a result of a decline in property prices, cap rates edge higher. Mortgage interest rates decrease during a construction bust because of less demand for loans. Consequently, when new construction ceases, mortgage interest rates are low and cap rates are high. Lenders are willing to lend but few people want to borrow.

Take the US market as an example. Commercial mortgage flow in the US is much more highly correlated with new construction than with cap rates or mortgage interest rates. The correlation between commercial mortgage flow and new construction is 76.7%, while the correlation between commercial mortgage flow and the difference between cap rate and mortgage interest rate is 57.8%. Exhibit 3-10 presents the trend of commercial mortgage flow, cap rate, mortgage interest rate and new construction in the US market.

Exhibit 3-10 shows that the commercial mortgage flow reaches a peak during a construction boom and hits the bottom during a construction bust. When commercial mortgage flow ascends to the top, both the mortgage interest rate and cap rate are high. When the commercial mortgage flow hit the bottom in 1993, the cap rate and the mortgage interest rate dropped to their lowest points as well.

Exhibit 3-10 Cap rate, mortgage interest rate, new construction and commercial mortgage flow in the US



Chapter 4. Mortgage interest rate and loan to value ratio

4.1 Mortgage interest rate

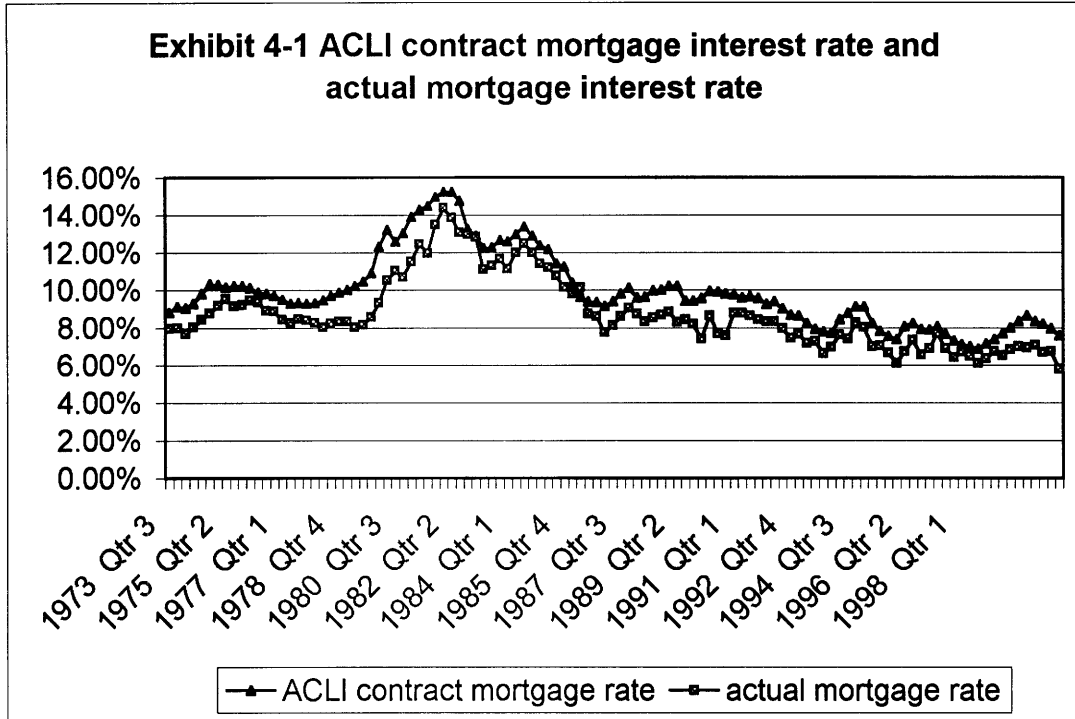
Introduction

Commercial mortgage interest rate measures the cost of debt. It is an important factor determining commercial mortgage demand. The demand for commercial mortgages is negatively correlated with mortgage interest rates. In other words, when mortgage interest rate rises, demand for commercial mortgage falls.

Commercial mortgage interest rates is comprised of the cost of funds and the lender's profit. Cost of funds is comprised of the cost of borrowing, the cost of originating, and the cost of servicing. The lender's profit is the return rewarding lenders for taking risks associated with mortgage lending. These risks include interest rate risk, prepayment risk, liquidity risk and default risk.

Historical trend of mortgage interest rate in the US

Exhibit 4-1 depicts (should spell this out) ACLI quarterly contract mortgage interest rates for all property types and the real ACLI mortgage interest rate from the third quarter of 1973 to the first quarter of 2001. Actual ACLI mortgage interest rates are obtained by subtracting the inflation rate from the ACLI contract mortgage interest rate. Exhibit 4-1 indicates that the ACLI contract mortgage interest rate and actual mortgage interest rate reached a peak in the second quarter of 1982. The average ACLI contract mortgage interest rate is 9.93%, with a standard deviation of 0.02.



ACLI mortgage interest rates for different types of income properties are very similar. Historically, hotel and apartment properties have the highest and lowest average mortgage interest rate, respectively. The average and standard deviation of quarterly ACLI mortgage interest rates from 1971 to 1998 for various property types are shown in Table 4-1.

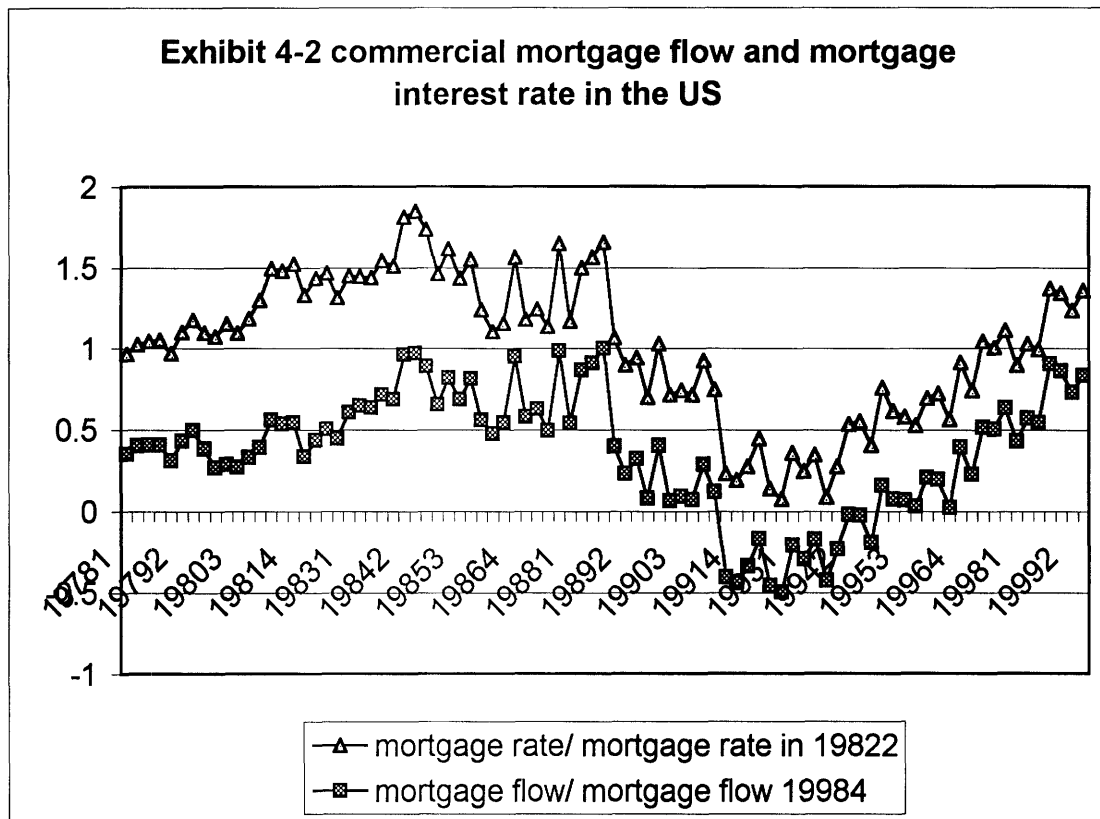
Table 4-1 Average and standard deviation of ACLI mortgage interest rate for different properties

	Apartment	Office	Retail	Industry	Hotel
Average	9.78%	9.97%	9.97%	10.01%	10.49%
Standard deviation	0.01754	0.018788	0.019952	0.019893	0.020193

Mortgage interest rate and commercial mortgage flow

Exhibit 4-2 presents the trend of commercial mortgage flow and mortgage interest rates in the US from 1978 to 1999. Notice that when mortgage interest rate declined to its lowest point in 1993, commercial mortgage flow also reached bottom. The correlation between commercial mortgage flow and mortgage interest rates in the US is 0.30. This

result seems contradictory . Because mortgage interest rates negatively affect commercial mortgage demand, one would expect to see it negatively correlate with commercial mortgage flow. This phenomenon is the result of interactions between mortgage demand and mortgage supply. The supply of mortgages influences commercial mortgage prices via mortgage demand. When demand for mortgages is high, mortgage interest rate rises. When demand for mortgages is low, mortgage interest rates fall.



Note: Mortgage rate in 19822 means mortgage interest rate in 1982 second quarter.

4.2 Loan to value ratio

The loan to value ratio describes property leverage status. It is an important loan underwriting standard established by lenders. Together with the new construction variable, it quantifies commercial mortgages used to take out construction loans.

The loan to value ratio can affect investor's equity return. If the total return on real estate investment is greater than the cost of debt, then the higher the loan to value ratio, the greater the return on equity. Here the risk associated with debt financing is not taken into account. Commercial mortgage demand rises and falls with the return on equity. Therefore, commercial mortgage demand should move in the same direction with the loan to value ratio.

However, the commercial mortgage flow data in the US indicates that it is negatively correlated with the loan to value ratio. The correlation is -0.31 . This is unexpected if one only considers the impact of mortgage demand upon mortgage flow. Explanation for this phenomenon can be found from the mortgage supply side. The loan to value ratio is determined by commercial mortgage lenders, not by borrowers. Therefore, it is a variable defined by the mortgage supply side. Borrowers want as much debt as possible if return on investment is greater than cost of debt. However, lenders constrain borrowers with loan to value ratio. When mortgage flow is high, lenders reduce the loan to value ratio. As a result, loan to value ratio is negatively correlated with commercial mortgage flow. The Exhibit 4-3 depicts the historical trend of commercial mortgage flow and loan to value ratio in the US. The data indicates that when mortgage flow rises, the loan to value ratio falls. When mortgage flow falls, the loan to value ratio rises.

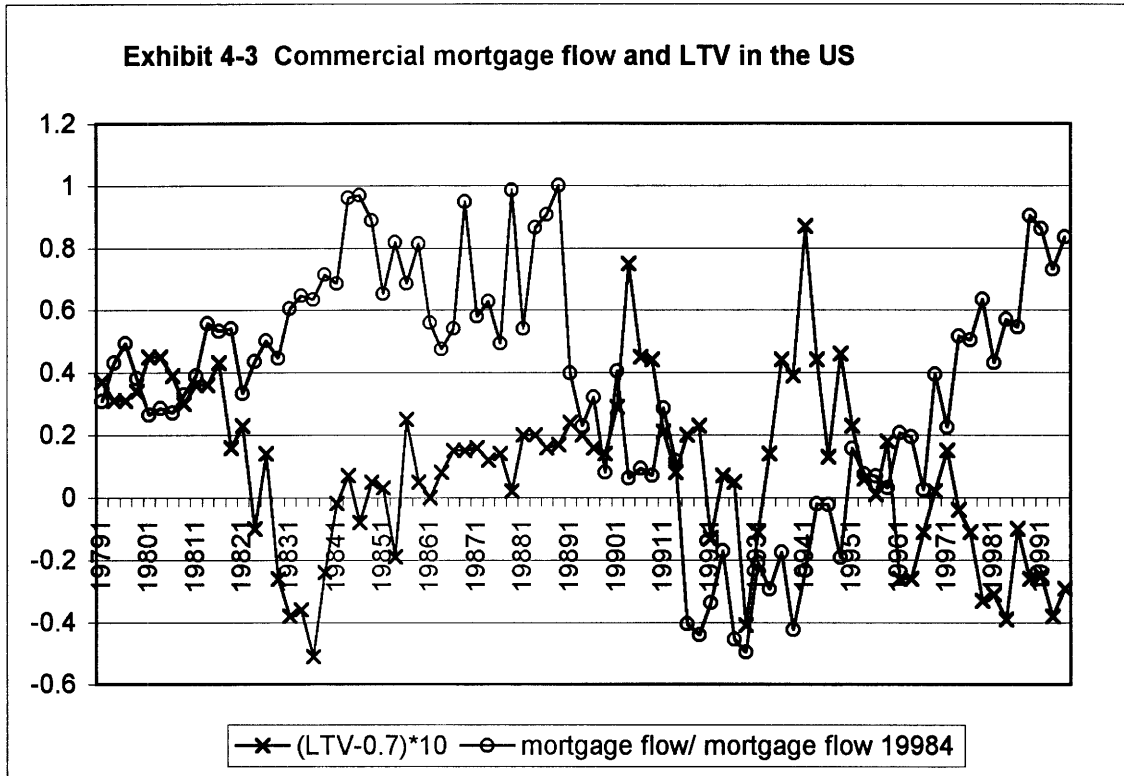
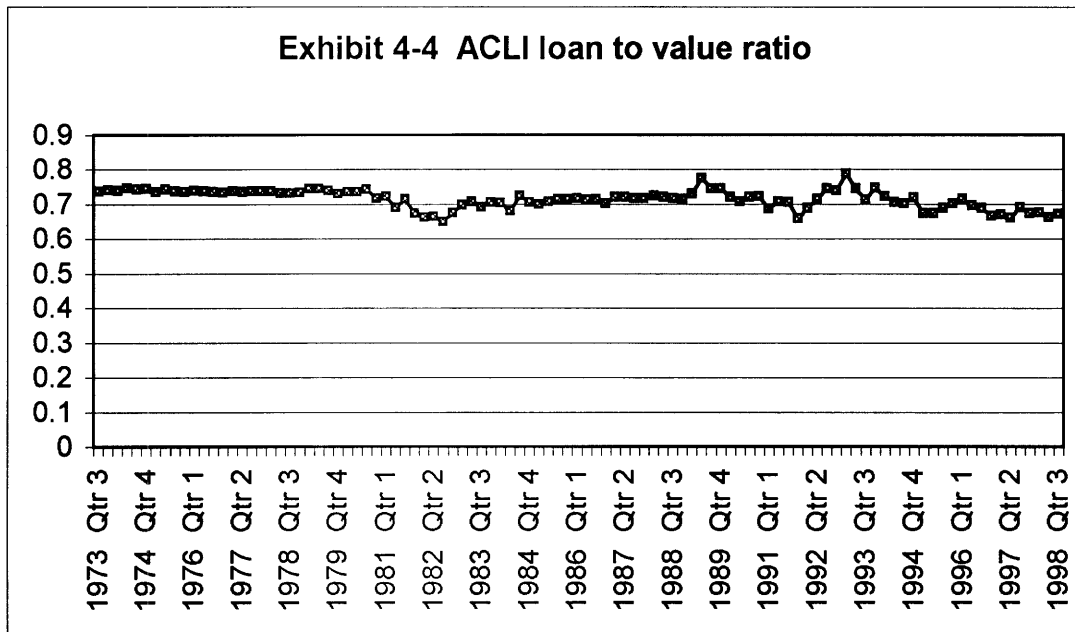


Exhibit 4-4 depicts the trend of the ACLI loan to value ratio from 1973 to 1998. Loan to value ratio flows around 0.7 with an average of 0.714 and a standard deviation of 0.027.



Chapter 5 US commercial mortgage demand estimation and forecast

5.1 Data

This section explains data used to build the US commercial mortgage demand equation.

The endogenous variable is commercial mortgage net flow. Exogenous variables of commercial mortgage demand model in U.S. market include cap rate, mortgage interest rate, loan to value ratio, new construction of income properties, and stock of income properties.

Mortgage interest rate and loan to value ratio data are from ACLI (American Council of Life Insurers) Investment Bulletin. These data were published quarterly from 1978 to 1998.

The Cap rate is constructed using NCREIF cap rates, ACLI loan to value ratio and mortgage interest rate. NCREIF(National Council of Real Estate Investment Fiduciary) cap rate is a cap rate for all equity-financed properties. It is an equity cap rate, not the overall cap rate for properties financed with both debt and equity. The formula used to calculate cap rate for leveraged property is:

$$Cap = \frac{L}{V} * mr + \left(1 - \frac{L}{V}\right) * Cap_E \quad (5.1)$$

Where

Cap ----overall cap rate;

Cap_E ---equity cap rate;

mr ---- mortgage interest rate;

$\frac{L}{V}$ -- loan to value ratio;

The Cap rate data is quarterly data from 1978 to 1998.

Data of new construction completed is from Bureau of Census. The data is seasonally adjusted (in US\$ in 1996). It is the sum of private industrial, commercial and office properties completed each year. The quarterly construction data starts from 1978 and ends at the first quarter of the year 2001.

The Stock of commercial property space is also constructed. By summing the value of completed space from 1964 to 1977, a base value of existing space is established. The stock of space in a given year t would be represented by the sum of the value of existing stock variable for year t-1 and the value of new construction variable for year t. The quarterly stock data starts from 1978 and ends at the first quarter of the year 2001.

Commercial mortgage net flow data is from the Federal Reserve website. It is the change in commercial mortgage outstanding. Commercial mortgage net flow is the sum of gross lending (new origination) and old loan retirement. Before it is used in the regression analysis, it is deflated (US\$ in 2001). The mortgage flow data starts from 1978 and ends at the first quarter of 2001. Its unit is in million \$.

5.2 US commercial mortgage demand estimation

US commercial mortgage demand equation

Commercial mortgage demand equation in the US is:

$$\begin{aligned}
 MD_t = & 506163 - 2.6 * 10^7 mr_{t-1} + 2.8299 * 10^7 cap_{t-1} + 0.485 Cons_t \\
 \text{t-stat} & \quad 2.757 \quad \quad -4.23 \quad \quad \quad 3.72 \quad \quad \quad 8.99 \\
 & -7.678 * 10^5 LTV_t - 0.00448 stock_{t-5} \\
 \text{t-stat} & \quad \quad -4.91 \quad \quad \quad -3.91
 \end{aligned}
 \tag{5.2}$$

$$R^2 = 0.775 \quad N=75$$

Where

MD_t = mortgage demand in year t;

mr_{t-1} = mortgage interest rate in year t-1;

cap_{t-1} = cap rate in year t-1;

$Cons_t$ = new construction completed in year t;

LTV_t = loan to value ratio in year t;

$stock_{t-5}$ = stock of income property in year t-5;

t-*stat* = t statistics;

R^2 = R square;

N = number of observations;

The explanation of data used to build equation (5.2) can be found in the first section of this chapter.

Examining equation (5.2), one can realize that 77.5% of the change of commercial mortgage flow in the US can be explained by equation (5.2). Because the value of the t-statistics for all the variables is greater than 2, all the exogenous variables are statistically significant.

Commercial mortgage demand in the US increases as cap rate and new construction increase but decreases as the mortgage interest rate, loan to value ratio and stock of income properties decrease. Commercial mortgage demand in the US rises by \$ 282,990 million when cap rate increases by 1% but falls by \$260,000 million when mortgage interest rate increases by 1%. When new construction of income property increases by \$1 million, commercial mortgage demand increases by \$0.485 million. Commercial mortgage demand drops by \$ 0.00448 million if the stock of income property rises by \$1 million. If loan to value ratio falls by 1%, then commercial mortgage demand rises by \$7678 million.

The Significance of exogenous variables

In order to estimate the significance of each exogenous variable, the author of this thesis runs regression for five times. The first analysis includes one exogenous variable. Later on, the number of independent variables increases by one each time. The following equations are the result of these analyses.

$$MD_t = -2.256 \cdot 10^5 + 0.619 \text{Cons}_t$$

$$\text{t-stat} \quad -9.54 \quad \quad \quad 12.01$$

$$R^2 = 0.640 \quad N=83$$

$$MD_t = 71053 + 0.596 \text{LTV}_t - 4.037 \cdot 10^5 \text{Cons}_t$$

$$\text{t-stat} \quad 0.687 \quad 11.95 \quad \quad -2.94$$

$$R^2 = 0.675 \quad N=83$$

$$MD_t = 3.62 \cdot 10^4 + 1.696 \cdot 10^6 \text{cap}_{t-1} + 0.576 \text{Cons}_t - 3.972 \cdot 10^5 \text{LTV}_t$$

$$\text{t-stat} \quad 0.34 \quad \quad 1.44 \quad \quad 11.21 \quad \quad -2.91$$

$$R^2 = 0.683 \quad N=83$$

$$MD_t = 1.0967 \cdot 10^5 - 1.3 \cdot 10^7 \text{mr}_{t-1} + 2.073 \cdot 10^7 \text{cap}_{t-1} + 0.581 \text{Cons}_t - 3.729 \cdot 10^5 \text{LTV}_t$$

$$\text{t-stat} \quad -0.954 \quad \quad -2.71 \quad \quad 2.91 \quad \quad 11.74 \quad \quad -2.83$$

$$R^2 = 0.711 \quad N=83$$

$$MD_t = 506163 - 2.6 \cdot 10^7 \text{mr}_{t-1} + 2.8299 \cdot 10^7 \text{cap}_{t-1} + 0.485 \text{Cons}_t$$

$$\text{t-stat} \quad 2.757 \quad \quad -4.23 \quad \quad 3.72 \quad \quad 8.99$$

$$-7.678 \cdot 10^5 \text{LTV}_t - 0.00448 \text{stock}_{t-5}$$

$$\text{t-stat} \quad \quad -4.91 \quad \quad -3.91$$

$$R^2 = 0.775 \quad N=75$$

These equations reflect that new construction is the dominant factor for commercial mortgage flow. The variable of new construction therefore is the most significant independent variable. Other exogenous variables are close in terms of significance.

Loan to value ratio, stock of income property and commercial mortgage flow

What we find is that in equation (5.2) the sign of loan to value ratio is negative, which is contradicting to the prediction made in chapter 2. In chapter 2, we predict that in commercial mortgage demand equation, the sign of loan to value ratio is positive. Why is the sign of loan to value ratio negative rather than positive? The possible answer lies in the mortgage supply side. From borrower's perspective, if the cost of debt is less than the total return and risks associated with debt financing is ignored, then the higher the loan to value ratio, the better. However, loan to value ratio is determined not by mortgage borrowers, but by mortgage lenders. When commercial mortgage demand is high, lenders have more control over loan underwriting. Lenders can adjust underwriting policy and restrict loan to value ratio so that lower loan to value ratio loans are more popular.

We also find that in equation (5.2), stock has a negative sign. Before one explains why the sign of stock is negative, it may be helpful to know the relationship between the commercial mortgage outstanding and the stock of existing income properties. Take the US commercial mortgage outstanding as an endogenous variable and the stock of space as an exogenous variable to run regressions. Mortgage outstanding data and stock of space data are quarterly data from 1978 to the first quarter of 2001. The mortgage outstanding data is also from Federal Reserve. Regression results are demonstrated as the following:

$$\begin{aligned} \text{Mortgage outstanding} &= 374887.7 + 0.012 \text{ Stock} \\ \text{t-statistics} & \qquad \qquad 8.14 \qquad \qquad 10.91 \\ R^2 &= 0.56 \qquad \qquad N=93 \end{aligned}$$

The regression result evidences that stock of space is the dominant factor for the level of commercial mortgage. Commercial mortgage outstanding grows with stock of space.

The sign of stock in mortgage outstanding equation is positive. Why is it negative in mortgage flow equation?

One possible explanation rests on the connection between stock and commercial mortgage net flow. Commercial mortgage net flow is the sum of new mortgage origination and old mortgage retirement. New construction consumes most of the newly originated mortgages. The rest of it flows into existing properties. Meanwhile, only existing properties have connection with old mortgages. Stock of space then explains both the demand for second mortgages and the payoffs of old loans. Assume the equation for newly originated mortgages, old loan retirement and mortgage flow can be written in this way.

Newly originated mortgages= a_1 *new construction+ a_2 *stock + a_3 *other elements

Old loan retirement= b_1 *stock+ b_2 *other factor

Mortgage net flow= a_1 *new construction+ a_2 *stock- b_1 *stock+ a_3 *other elements
- b_2 *other factor

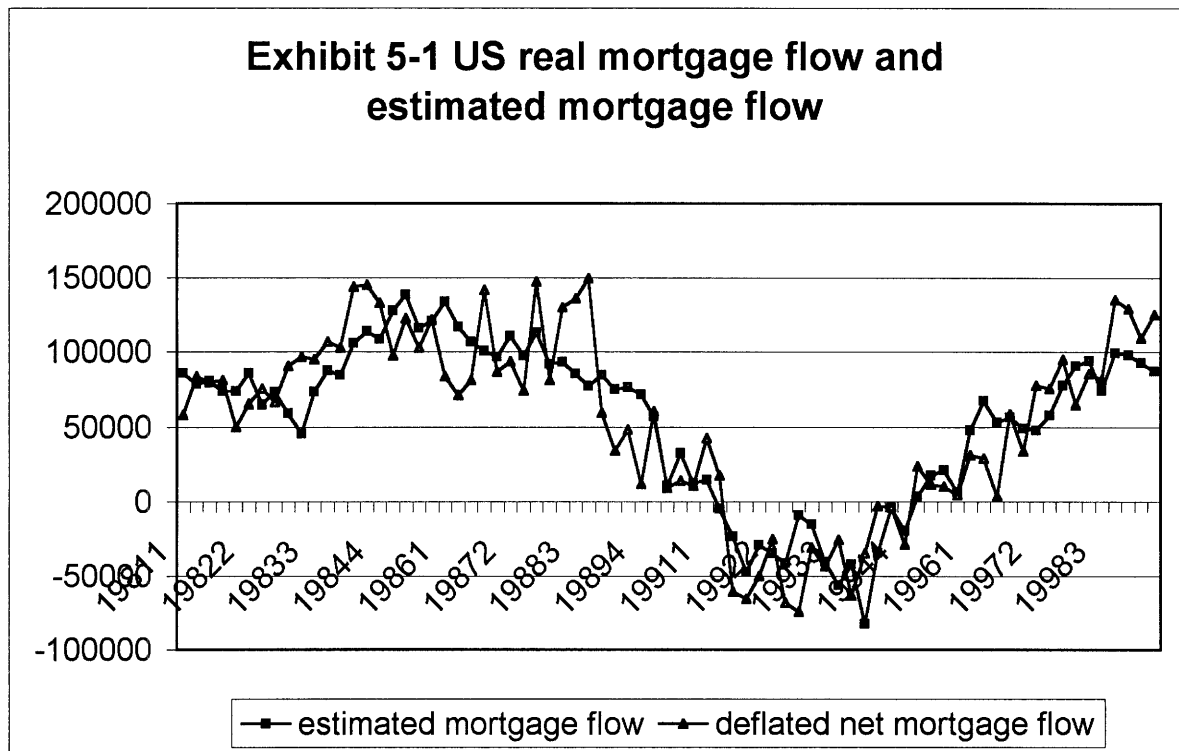
If the value of a_2 is less than the value of b_1 , then the sign of stock is negative in the commercial mortgage flow equation. This is possible if the value of newly originated commercial mortgages that flow into existing properties is less than the value of retired old loans.

The fact that stock has a negative sign might also be attributed to the stock data. The stock value used in this thesis actually is the book value. It measures the original construction cost. What matters with commercial mortgage demand is the market value

of stock, how much it is worth. The book value of stock grows but the market value of stock may decline over time. Difference between the book value of stock and market value of stock also causes the stock to have a negative sign. If the market value of stock is used to run the regression, the sign of the stock is likely to be positive.

Mortgage flow and estimated mortgage flow

Exhibit 5-1 presents real commercial mortgage flow and the commercial mortgage flow estimated by equation (5.2). Notice that during the years between 1986 to 1990, the model doesn't work very well. In the rest of the time, the model works quite well and the estimated trend of commercial mortgage flow is very close to the actual trend of commercial mortgage flow.



5.3 US commercial mortgage demand forecast

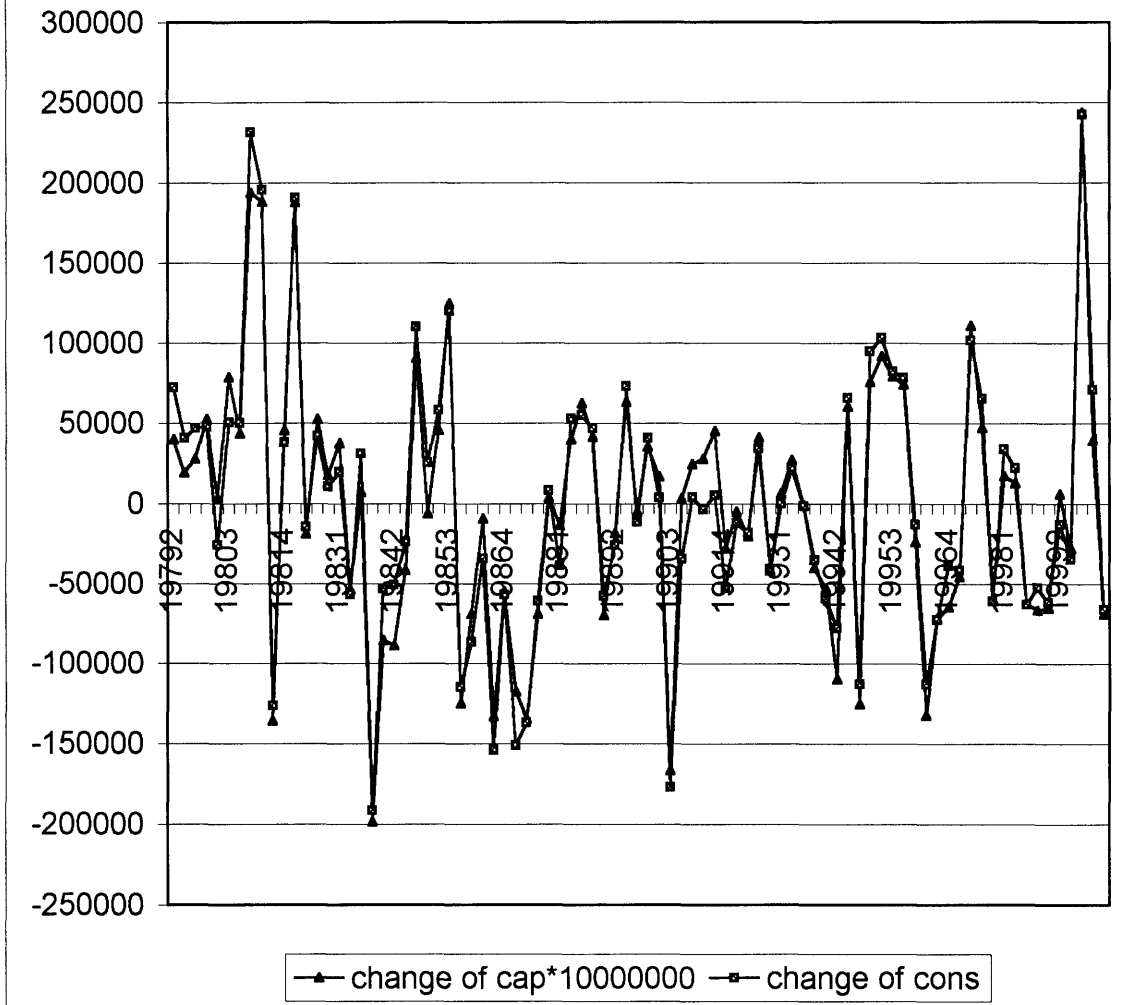
With USA commercial mortgage demand equation (5.2), one can predict commercial mortgage demand in the next two years. The trend of independent variable should be predicted before one can estimate the commercial mortgage flow.

There are five independent variables. As we know, mortgage stock lags commercial mortgage flow for five years. Therefore, mortgage flow in the year of 2002 and 2003 is affected by stock of space in the year of 1997 and 1998. The value of stock in 1997 and 1998 is already known. What left to be forecasted is the trend of other four variables--- new construction, cap rate, mortgage interest rate and loan to value ratio.

Connection among independent variables

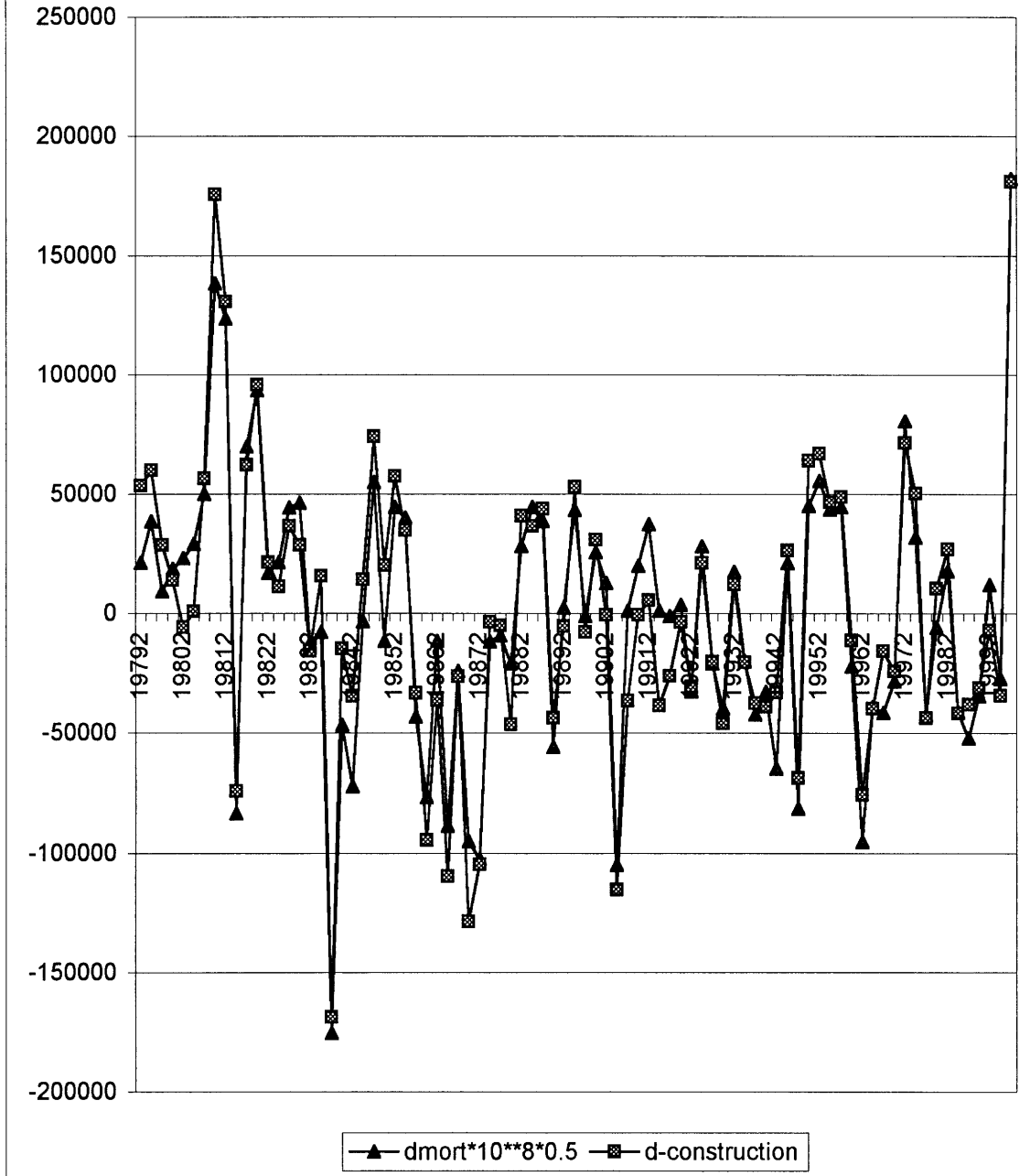
If one studies the historical variation trend of construction, cap rate, mortgage interest rate and loan to value ratio in the US, one would notice that the change of new construction moves closely with the changes of cap rate, mortgage interest rate and loan to value ratio. Exhibits 5-2 , 5-3 and 5-4 demonstrate the change of new construction completed and the change of cap rate, the change of mortgage interest rate and the change of loan to value ratio. In exhibits 5-2 and 5-3, the value of new construction completed lags the value of cap rate and mortgage interest rate for one year due to the construction period. The change of new construction in year t is compared with the change of cap rate and mortgage interest rate in year $t-1$. Exhibits 5-2 and exhibit 5-3 show that the change of completed new construction in year t always moves in the same direction as the change of cap rate and mortgage interest rate in year $t-1$. Exhibit 5-4 demonstrates that the change of newly completed construction in year t is highly consistent with the change of loan to value ratio in the same period. In general, one can predict the variation trend of cap rate, mortgage interest rate and loan to value ratio using the variation trend of newly completed construction.

Exhibit 5-2 Change of cap rate and change of new construction in the US



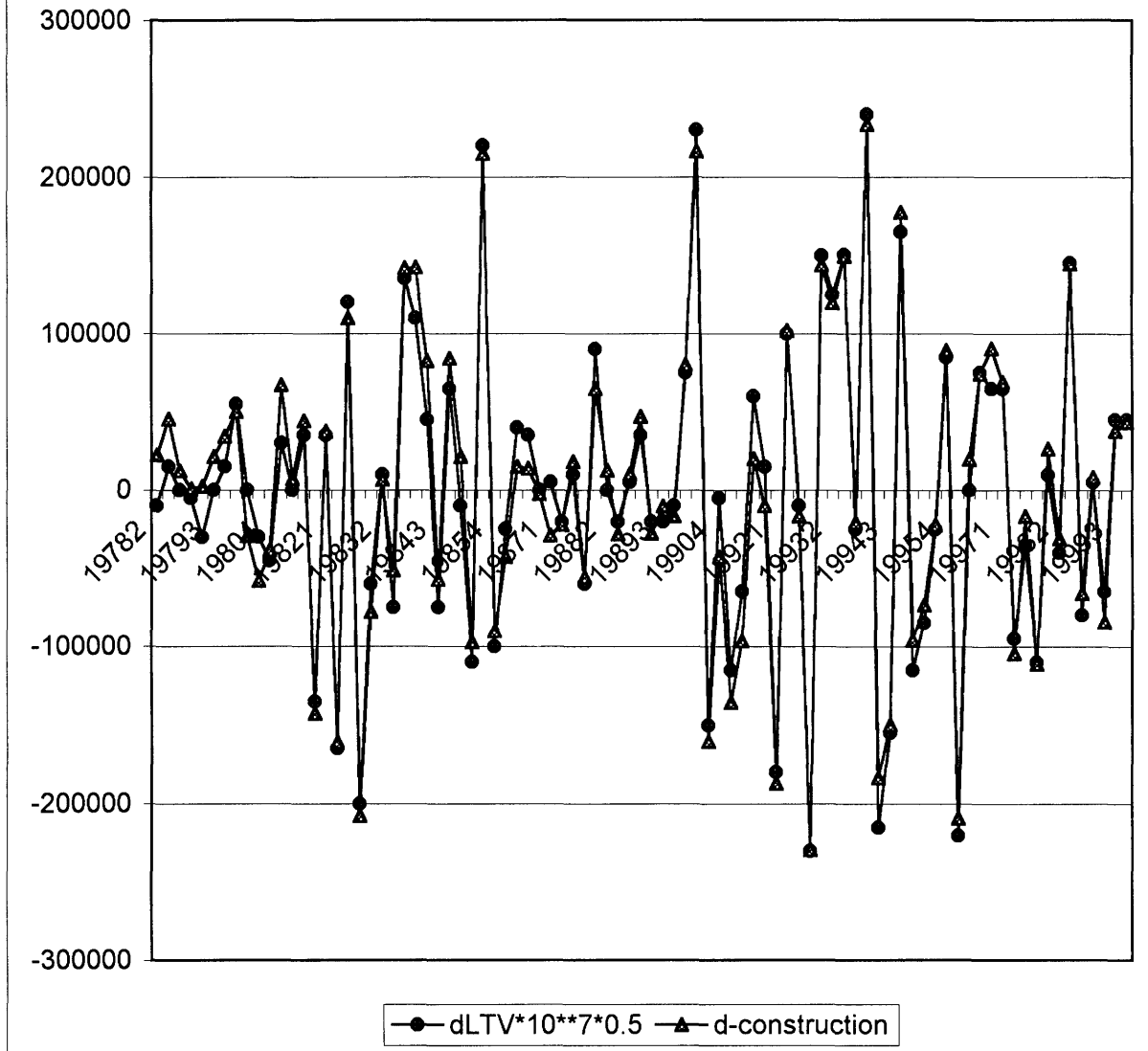
note: Change of cap in year t = $cap(t) - cap(t-1)$; where cap(t) is cap rate in year (t);
 Change of cons in year t = $cons(t) - cons(t-1)$; where cons(t) is new construction completed in year t; Here change of new construction in year t is compared with change of cap rate in year t-1.

Exhibit 5-3 Change of new construction and the change of mortgage rate in the US



note: $dmort(t) = mr(t) - mr(t-1)$; where $mr(t)$ is mortgage interest rate in year t ;
 $dcons(t) = cons(t) - cons(t-1)$; where $cons(t)$ is new construction completed in year t ;
 Here $dcons(t)$ is compared with $dmort(t-1)$.

Exhibit 5-4 Change of new construction and the change of LTV in the US



$$dLTV*10^{7*0.5}(t)=(LTV(t)-LTV(t-1))*5000000;$$

$$d-construction(t)=construction(t)-construction(t-1);$$

Here d-construction in year t is compared with dLTV in year t.

Forecast most likely commercial mortgage demand

Before forecasting the commercial mortgage demand, one also need to know the historical trend of each variable. Table 5-1 demonstrates the historical variation speed of each variable in one quarter with high frequency.

Table 5-1 Variation speed of variables

Variable name	Unit of speed	Average rise speed	Average fall speed	Maximum rise speed	Maximum fall speed
New construction completed	\$ million per quarter (1996 price)	7800	4090	31000	39000
Cap rate	Base point per quarter	31	30	79	67
Mortgage interest rate	Base point per quarter	24	4	112	140
Loan to value ratio	Base point per quarter	85	45	470	450

Torto Wheaton Office Outlook, spring 2001, predicts that new construction in the US in the next two years is still strong. Here the author assumes trends of new construction in the next two years. Table 5-2 shows the seven scenarios of new construction change. In this table, '+7800' represents new construction rises by \$ 7,800 million, '-4090' represents new construction falls by \$ 4,090 million and '0' represents new construction staying still.

Table 5-2 Possible movement of new construction in near term future

Time	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
2001-2	7800	7800	0	7800	7800	0	7800
2001-3	7800	7800	0	-4090	7800	0	7800
2001-4	7800	7800	0	7800	-4090	0	7800
2002-1	7800	-4090	-4090	-4090	-4090	0	7800

Table 5-2 continue:

2002-2	7800	-4090	-4090	7800	7800	0	7800
2002-3	7800	-4090	-4090	-4090	7800	0	-4090
2002-4	7800	-4090	-4090	7800	-4090	0	-4090
2003-1	-4090	-4090	-4090	-4090	-4090	0	-4090
2003-2	-4090	-4090	-4090	7800	7800	0	-4090
2003-3	-4090	-4090	-4090	-4090	7800	0	-4090
2003-4	-4090	-4090	-4090	7800	-4090	0	-4090

In each scenario, one can predict the trend of other three variables based on the variation of new construction. If new construction rises by 7,800 million dollar, then cap rate rises by 31 bps, mortgage interest rate rises by 24 bps and loan to value ratio rises by 85 bps. On the other hand, if new construction falls by 4,090 million dollars, then cap rate falls by 30bps, mortgage interest rate falls by 4 bps and loan to value ratio falls by 45bps. Table 5-3 presents the change of variables in scenario 1.

Table 5-3 Change of variables in scenario 1

Time	Change of New construction (mil \$)	Change of cap rate (bps)	Change of Mortgage interest rate (bps)	Change of Loan to value ratio (bps)
2001-2	7800	31	24	85

Table 5-3 continue:

2001-3	7800	31	24	85
2001-4	7800	31	24	85
2002-1	7800	31	24	85
2002-2	7800	31	24	85
2002-3	7800	31	24	85
2002-4	7800	31	24	85
2003-1	-4090	-30	-4	-45
2003-2	-4090	-30	-4	-45
2003-3	-4090	-30	-4	-45
2003-4	-4090	-30	-4	-45

Once the value of independent variables is predicted using the method shown in table 5-2 and table 5-3, one can predict the value of commercial mortgage demand in each scenario by using equation (5.2). What we call most likely commercial mortgage demand is the average of commercial mortgage demand of these seven scenarios. It is shown in the following table.

Table 5-4 The most likely US commercial mortgage demand in next the two years

Time	Most likely US commercial mortgage demand (mil \$,2001 price)
20012	96252
20013	76837
20014	53181
20021	42530
20022	38060
20023	24538

Table 5-4 continue:

20024	13577
20031	-3598
20032	-14674
20033	-28818
20034	-43025

Table 5-4 shows that commercial mortgage demand in next two years will decrease gradually.

5.4 Conclusions

Analysis of the US commercial mortgage demand leads to the following conclusions:

1. US commercial mortgage demand increases as the cap rate and new construction rate increase but decreases as the mortgage interest rate, loan to value ratio and stock of income property decrease. New construction is the dominant factor that influences US commercial mortgage demand. Cap rate, mortgage interest rate, loan to value ratio and stock of space also have significant impact upon US commercial mortgage demand. All the exogenous variables are statistically significant.
2. The US new construction completed in year t moves in the same direction with cap rate and mortgage interest rate in year t-1 and loan to value ratio in year t.
3. The US new construction in next two years is predicted to be strong. Using commercial mortgage demand model built in this chapter, one can predict that US commercial mortgage demand in the next two years will fall gradually.

Chapter 6 UK commercial mortgage demand estimation and forecast

6.1 Data

This section explains data used in UK commercial mortgage demand equation.

The Endogenous variable in the UK commercial mortgage demand equation is the UK net commercial mortgage flow. The Exogenous variables include new construction, cap rate and actual mortgage interest rate.

The UK commercial mortgage flow in year t is the difference of commercial mortgage outstanding in year t and in year $t-1$. Data of commercial mortgage outstanding comes from Bank of England. It is the sum of commercial mortgage outstanding of banks, insurance companies, building societies and securitized debts. The data is collected annually from 1970 to 2000 in real 2000 price. The unit is in £ million.

Construction data is from Construction Market Intelligence, Department of Environment, Transport and Regions of UK. The construction data is the new aggregate orders obtained by contractors. The construction data used here is the sum of new orders of private industrial and private commercial buildings obtained by contractors in UK. It is in current price. The construction data start from 1989 and end at 1999. The unit is in £ million.

Cap rate data is from Jones Lang LaSalle. It is annual data starting from 1984 ending at 1997. Mortgage interest rate used here is actual mortgage interest rate in UK from 1972 to 2001. It is the difference between nominal mortgage interest rate and inflation rate. Nominal mortgage interest rate is from Bank of England. Actual mortgage interest rate here replaces nominal mortgage interest rate to get rid of the influence of inflation rate. From 1979 to 1981 and from 1989 to 1991, UK has relatively high inflation rate.

Data used to run regression is shown in table 6-1.

Table 6-1 data of variables

Time	Commercial Mortgage flow (£ million)	Cap rate	Construction (£ million)	Actual mortgage interest rate
1989	10238	0.0642	12976	0.0620
1990	15238	0.0783	10646	0.0310
1991	10000	0.0775	7929	0.0460
1992	2381	0.0767	5723	0.0450
1993	-7143	0.0700	6028	0.0355
1994	-4762	0.0590	7075	0.0235
1995	952	0.0595	8603	0.0158
1996	1429	0.0610	8727	0.0237
1997	2381	0.0583	10673	0.0188

The historical average rise and fall speed of each variable is shown in table 6-2

Table 6-2 Average rise and fall speed of UK cap rate, actual mortgage interest rate, and new construction

Variable name	Unit of speed	Average rise speed	Average fall speed
Cap rate	Base point per year	43.3	42.2
Actual mortgage interest rate	Base point per year	78.6	88.6
New construction	Million pound per year	1140	2018

6.2 UK commercial mortgage demand estimation

UK commercial mortgage demand equation

Using data described in the last section, one can obtain an UK commercial mortgage demand equation.

$$\begin{array}{l} \text{MD}(t) = - 62189 + 2.65 \text{ Cons}(t) + 670056 \text{ cap}(t) - 74206 \text{ mr}(t) \\ \text{t-statistics} \quad -5.42 \qquad \qquad 5.36 \qquad \qquad 4.22 \qquad \qquad -0.84 \end{array} \quad (6.1)$$

$$R^2 = 0.894, N=9$$

Where

$\text{MD}(t)$ = commercial mortgage demand in year t ;

$\text{mr}(t)$ = real mortgage interest rate in year t ;

$\text{cap}(t)$ = cap rate in year t ;

$\text{Cons}(t)$ = construction order obtained by contractors in year t ;

R^2 = R square;

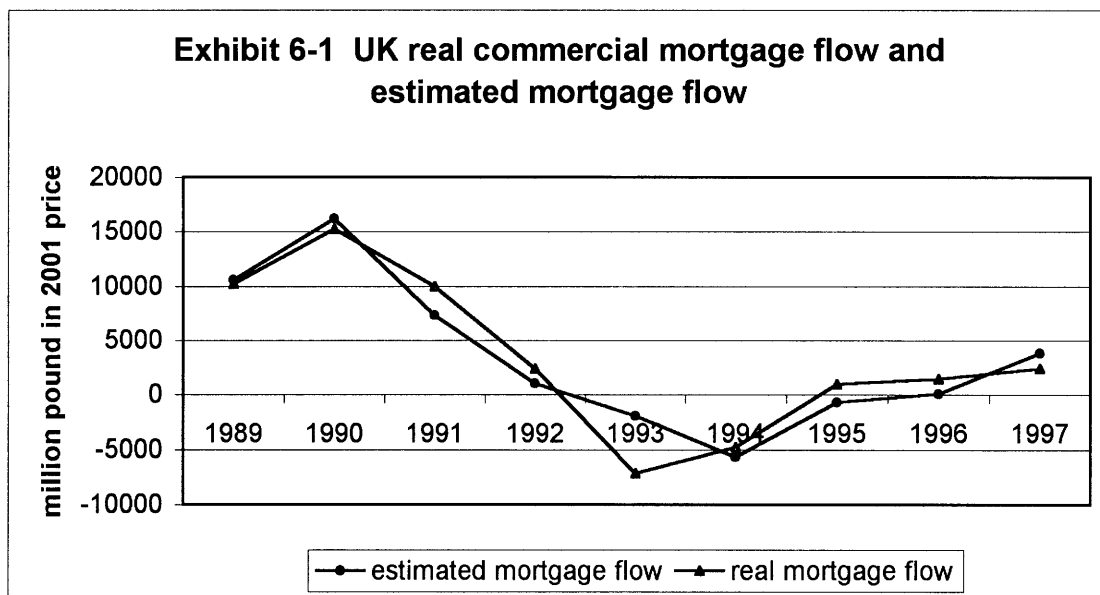
N = number of observations

By Examining equation (6.1), one can realize that 89.4% of commercial mortgage flow variation in the UK can be explained by equation (6.1). Because the value of t-statistics for cap rate and new construction is greater than 2, they are statistically significant. Nevertheless, t-statistics of mortgage interest rate is less than 2, it seems to be statistically insignificant.

Commercial mortgage flow in the UK increases with cap rate and new construction but decreases with mortgage interest rate. Commercial mortgage flow in the UK rises by £ 6700 million when cap rate increases by 1% but falls by £ 742 million when mortgage interest rate increases by 1%. When orders of new construction obtained by UK

contractors increases by £1 million, commercial mortgage flow increases by £ 2.65 million

Exhibit 6-1 represents real commercial mortgage flow and estimated commercial mortgage flow in UK. It manifests that most of the time, estimated commercial mortgage flow is quite close to real commercial mortgage flow.



Significance of independent variables

To estimate the significance of each independent variable, we run regression analysis for three times. Each time we change the number of independent variables. The Result is shown as follows:

$$MD = - 10343 + 1.499 \text{ Cons}$$

t-statistics -1.55 2.18

$$R^2 = 0.354, N=11$$

$$MD = - 57945 + 2.489 \text{ Cons} + 590677 \text{ cap}$$

t-statistics -5.77 5.59 4.76

$R^2 = 0.879$, N=9

MD = - 62189 + 2.65 Cons + 670056 cap - 74206 mr

t-statistics -5.42 5.36 4.22 -0.84

$R^2 = 0.894$, N=9

The above three equations demonstrate that cap rate and new construction are the most important factors for UK commercial mortgage demand. Actual mortgage interest rate is not statistically important.

The relation among UK new construction, cap rate and mortgage interest rate

Using the data of UK new construction, cap rate and actual mortgage interest rate, one can analyze the relationship among these three variables. The following equation explains this relation.

Cons=15148.74-130315 cap+69066 mr

t-stat 2.11 -1.1 1.0

$R^2 = 0.197$ N=9

Where

Cons= construction order obtained by contractors;

mr = real mortgage interest rate;

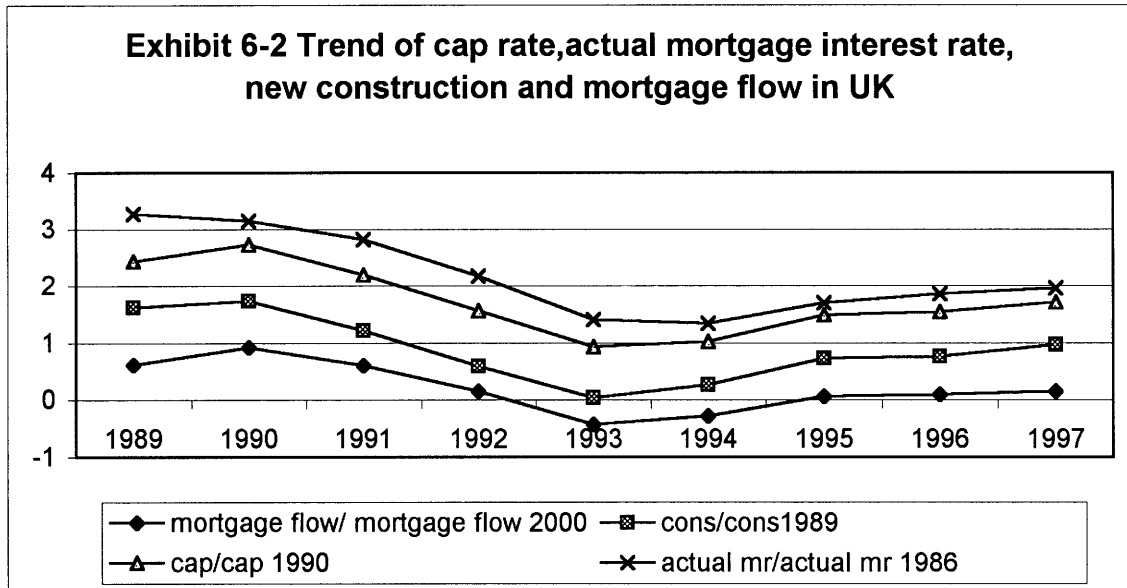
cap= cap rate;

R^2 = R square;

N= number of observations

Since R square is very low and t-statistics for cap rate and mortgage interest rate is less than 2, it seems that no determined linkage among UK new construction, cap rate and actual mortgage interest rate can be seen in the past ten years. Exhibit 6-2 demonstrates

the trend of UK new construction, cap rate and mortgage interest rate. It demonstrates that cap rate, actual mortgage interest rate, new construction and commercial mortgage flow in UK move in the same direction in years from 1989 to 1997.



6.3 Forecast UK commercial mortgage demand

Using the UK commercial mortgage demand equation (6.1), one can predict UK commercial mortgage demand in the near term future. Method used here is similar to that described in chapter 5.

Torto Wheaton Office Outlook, spring 2001, predicts that UK is now in the middle of a construction boom. Assume construction stays at the current level, cap rate reaches historical peak and actual mortgage interest rate drops to average low point, one can calculate the maximum commercial mortgage demand using equation (6.1). Assuming the construction value stays at current level, cap rate reaches the historically lowest point and actual mortgage interest rate rises to a historical average high value, one can obtain the minimum commercial mortgage demand in the near term future using equation (6.1). Table 6-2 presents the value of maximum and minimum commercial mortgage demand in

the UK and the value of each independent variable used to predict mortgage demand. Real UK commercial mortgage demand will fall in the range between the maximum mortgage demand and minimum mortgage demand if new construction is still strong.

Table 6-2 UK maximum and minimum commercial mortgage demand in near term future

Scenario	Cap rate	Actual mortgage interest rate	New construction (£ million)	Commercial mortgage demand (£ million)
Maximum mortgage demand	0.0783	-0.1167	11743	30060
Minimum mortgage demand	0.0533	0.0289	11743	2503

It is hard to forecast a narrower UK commercial mortgage demand range. Part of this is due to the lack of historical data. The data we have only covers the last ten years. Moreover, no clear linkage between the variation of UK new construction and the variation of UK cap rate and mortgage interest rate is seen. Therefore, all though we are quite sure about the trend of new construction in the near term future, we are still unable to predict the trend of cap rate and mortgage interest rate. There may be other ways to predict cap rate and mortgage interest rate but they are beyond the research of this thesis.

6.4 Conclusion

Based on the research conducted, one can reach the following conclusions:

1. UK commercial mortgage demand increases as cap rate and new construction increase, but decreases as actual mortgage interest rate decreases. Cap rate and

new construction are the most important factors that influence UK commercial mortgage demand.

2. In the near term future, UK is still in a construction boom. Commercial mortgage demand in UK depends mostly on the change of cap rate in the near term future.
3. Assuming the new construction in UK stays at current level and using UK commercial mortgage demand model established in this chapter, one can predict that UK commercial mortgage demand in the next two years will fall between £ 2503 million and £ 30060 million .

Chapter 7. Japan commercial mortgage demand estimation and forecast

7.1 Data

To analyze Japan commercial mortgage demand, four exogenous variables are considered. These are cap rate, mortgage interest rate, new construction and stock. The Endogenous variable is banking lending flow.

It is difficult to define commercial mortgages in Japan because there are several special features in Japanese real estate industry. First, high proportion of buildings are held by corporations, not by real estate companies, for instance, 40% of office buildings in Tokyo are corporate real estate. Second, almost all long-term lending for equipment funds is recourse with collateral on real estate. Third, most buildings are small, class B buildings held by individuals or small companies. (The six major real estate companies hold only 3% of the total properties.) Thus, one way to define commercial mortgage is to pick up the statistics on lending to the real estate industry or FIRE industry, although the coverage is relatively small. Another way is to include the other industries (e.g. manufacturing and service industries) though they include the funds for machinery and small equipments. Here thesis author uses the bank lending to real estate industry to estimate the commercial mortgage in Japan. Original mortgage data was quarterly time series. Here it is annualized. Mortgage data starts from 1978 ends at 2000. Its unit is in million yen. It is not seasonally adjusted.

Commercial mortgage interest rate is from Government Housing Loan Corporation of Japan. It is an annualized data from 1978 to 2000.

Cap rate is from Jones Lang LaSalle. It covers years from 1987 to 1997.

Table 7-1 describes construction data collected. Our analysis uses construction investment by real estate industry from 1978 to 1999. It is at market price in calendar year.

Stock value is constructed. Stock value in year t is the sum of base value of stock and new constructions in years from 1984 to year t. Base value of stock is the sum of all the new constructions from 1970 to 1983.

Table 7-1 Construction data of Japan

DATA	SOURCE	UNIT	INTERVAL	FROM	TO	CATEGORIES, etc.
Private Building Construction Started	Ministry of Construction	1000 square meters,	MONTHLY	Jan-82	Mar-99	by Use and by Industries
Value of Construction Orders Received	Ministry of Construction	Million Yen	MONTHLY	Apr-59	Mar-99	By investor and by type
Capital Investment	Economy Planning Agency	Million Yen in real term	QUARTER LY	Jan-55	Dec-98	By industry, at market prices in calendar year of 1990

7.2 Japan Commercial mortgage demand estimation

Japan commercial mortgage demand equation

If fund flow to real estate industry is defined as commercial mortgage flow in Japan, then Japan commercial mortgage flow equation is:

$$\begin{aligned}
 MD(t) = & 23821414 + 1.39 \cdot 10^8 \text{ cap}(t-1) - 2.3 \cdot 10^8 \text{ mr}(t) + 3.03 \text{ Cons}(t-1) - 0.74 \text{ Stock}(t-3) \\
 \text{t-statistics} & \quad 6.18 \qquad \qquad \qquad 1.81 \qquad \qquad \qquad -4.50 \qquad \qquad \qquad 3.03 \qquad \qquad \qquad -7.97
 \end{aligned}
 \tag{7.1}$$

$$R^2 = 0.958, N = 11$$

Where

$$MD(t) = \text{bank lending flow to real estate industry in year } t ;$$

$mr(t)$ = mortgage interest rate in year t;

$cap(t-1)$ = cap rate in year t-1;

Cons(t-1) = construction investment by real estate industry in year t-1;

Stock = Stock of construction investment by real estate industry in year t-3;

R^2 = R square;

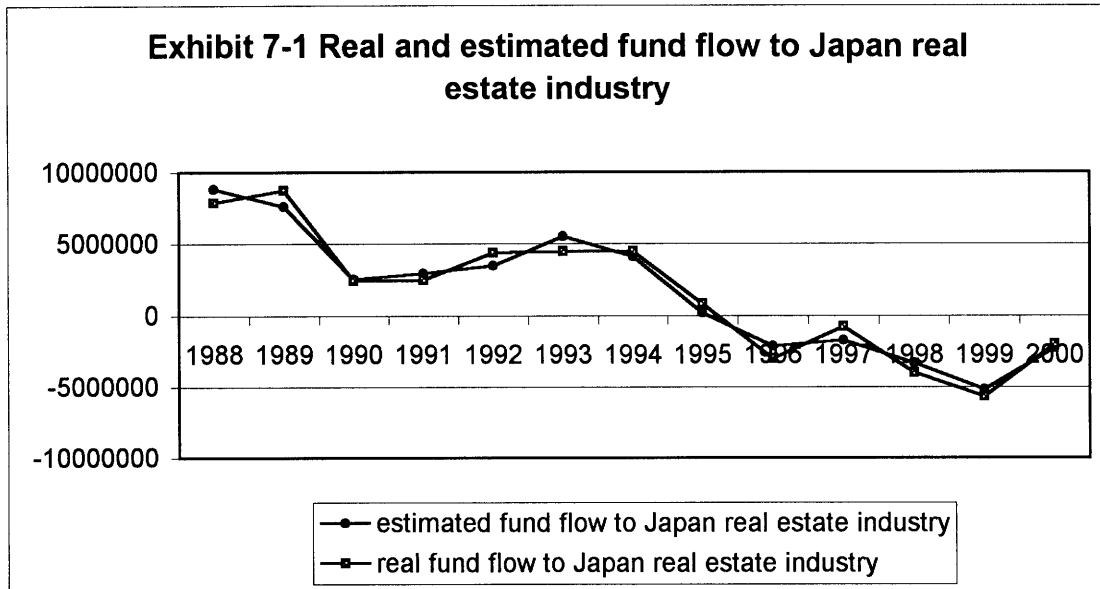
N = number of observations

95.8% of the variation of bank lending flow to Japan real estate industry can be explained by equation (7.1). Mortgage flow to real estate industry increases with cap rate and new construction but decreases with mortgage interest rate and stock. If cap rate rises by 1%, mortgage flow to real estate industry rises by 1390000 million yen. If new construction investment by real estate industry increases by 1 million yen, then mortgage flow to real estate industry increases by 3.03 million yen. On the other hand, mortgage flow drops by 2300000 million yen and 0.74 million yen respectively when mortgage interest rate falls by 1% and stock of construction investment by real estate industry increases by 1 million yen.

Since the value of t-statistics for mortgage interest rate, new construction and stock are greater than 2, these three variables are statistically significant. Cap rate is not statistically significant though it is an important factor in mortgage flow.

Real fund flow and estimated fund flow

Exhibit 7-1 presents real and estimated fund flow to Japan real estate industry. It shows that estimated fund flow is quite close to the real fund flow.



Stock and Japan commercial mortgage flow

What is the most important factor of commercial mortgage flow in Japan If bank fund flowing into the real estate industry is defined as Japan commercial mortgage flow, then stock of real estate new construction is the most important factors. Stock alone can explain 80% of the change of fund flow to real estate industry. Regression result is presented below.

$$MD(t) = 12856440 - 0.336 \text{ Stock}(t-3)$$

t-statistics 7.75 -6.98

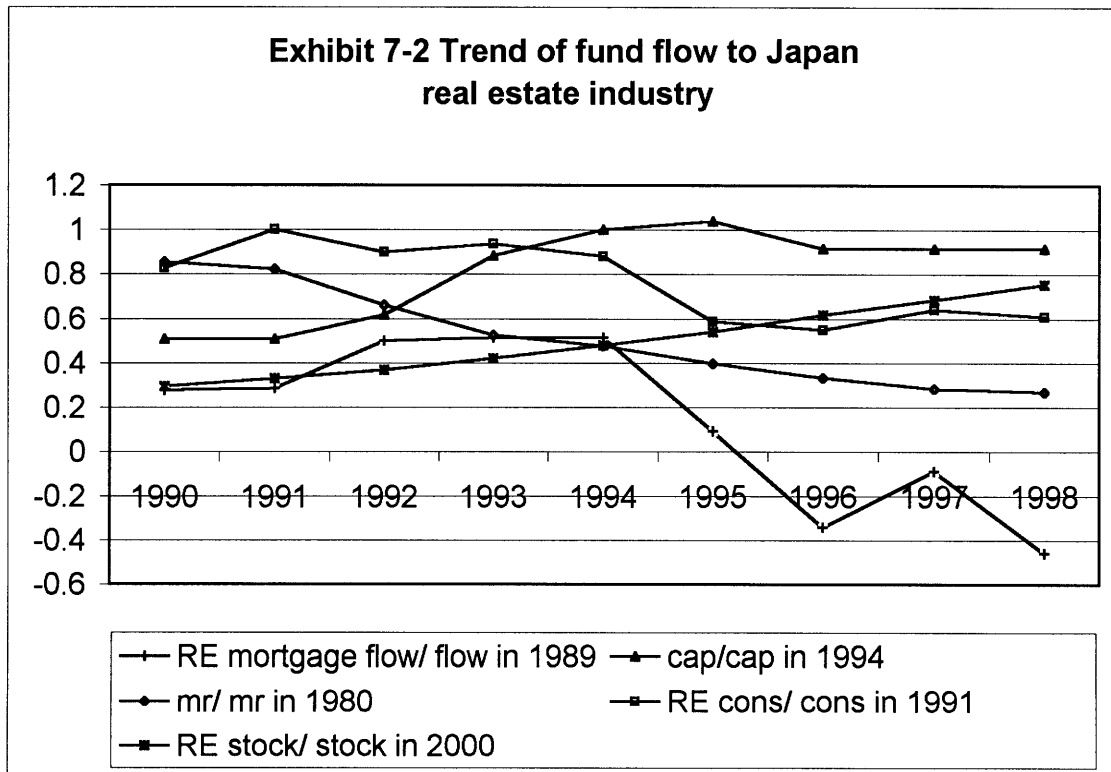
$$R^2 = 0.802, N = 14$$

The huge role of stock in the Japan commercial mortgage demand equation (7.1) can be interpreted as the problem between the book value and market value of stock. The value of stock in this thesis is the book value. It measures the original construction cost. What probably matters with commercial mortgage demand is what it is worth or the market value of stock, not the book value. This is particularly true in Japan where the stock has grown and its market value has declined sharply from 1989 to 1999.

Trend of mortgage flow in Japan

Exhibit 7-2 presents the trend of fund flow to Japan real estate industry.

Fund flow to Japan real estate industry reaches its maximum value when new construction and mortgage interest rate are relatively high while cap rate is relatively low. Fund flow to Japan real estate industry drops to the lowest point when new construction and mortgage interest rate are relatively low but cap rate is relatively high. Low cap rate means high property price for given net operating income. Therefore, when property price is high, new construction is relatively high and demand for mortgage rises, mortgage interest rate in turn rises. When everyone wants to borrow, the price of debt rises. On the contrary, high cap rate means low property price. When property price is low, new construction slows down and demand for mortgage falls, thus mortgage interest rate drops. In this situation, lenders are willing to lend but there is few people want to borrow.



7.3 Forecast Japan commercial mortgage demand

Using equation (7.1), one can predict fund flow to Japan real estate industry in the near term future. Before doing that, one needs to know the historical trend of each variable. Table 7-2 shows the trend of independent variables.

Table 7-2 Trend of independent variables

Variable name	Average high value	Average low value
Cap rate	0.039	0.02243
Mortgage interest rate	0.079	0.059
Real estate construction investment(million yen)	2767484	1891699

According to Torto Wheaton Office Outlook, Spring 2001, Japan is now in a middle of a construction surge caused by public sector spending. Assuming that in next two years new construction remains at the current level, then one can calculate the maximum mortgage flow to real estate industry given that cap rate equals historical average high and mortgage interest rate stays at year 2001 level. On the other hand, if cap rate equals to historical average low value, mortgage interest rate remains at historical low level, then the mortgage flow to real estate industry is called minimum mortgage flow to real estate industry.

Table 7-3 shows the maximum and minimum mortgage flow to Japan real estate in next two years. According to table 7-3, bank lending flow to Japan real estate industry in next two years are negative. That means the value of newly originated loans is less than the value of retired old loans

Table 7-3 Forecasted fund flow to Japan FIRES industries and real estate industry

time	Maximum flow to real estate industry	Minimum fund flow to real estate industry
2001	-4879096	-10126292
2002	-7475947	-14987499
2003	-10072798	-19848706

7.4 Conclusions

Japan commercial real estate market is more complicated than US market and UK market. Based on the research conducted, one can reach the follow conclusions:

1. Bank lending flow to Japan real estate industry increases with cap rate and new construction but decreases with mortgage interest rate and stock of construction.
2. Cap rate is not statistically significant though it has important impacts upon bank lending flow to Japan real estate industry. Mortgage interest rate, new construction and stock are statistically significant. Stock is the most important factor for bank fund flow into the Japan real estate industry during the past ten years.
3. Bank lending flow into Japan real estate industry is high when cap rate is relatively low but mortgage interest rate and new construction is relatively high. Bank lending flow into Japan real estate industry is low when cap rate is relatively low but mortgage interest rate and new construction is relatively low.
4. In the near term future, bank lending flow to Japan real estate industry is predicted to be negative. The value of newly originated loans to real estate industry is less than the value of retired old loans.

Chapter 8. Conclusion

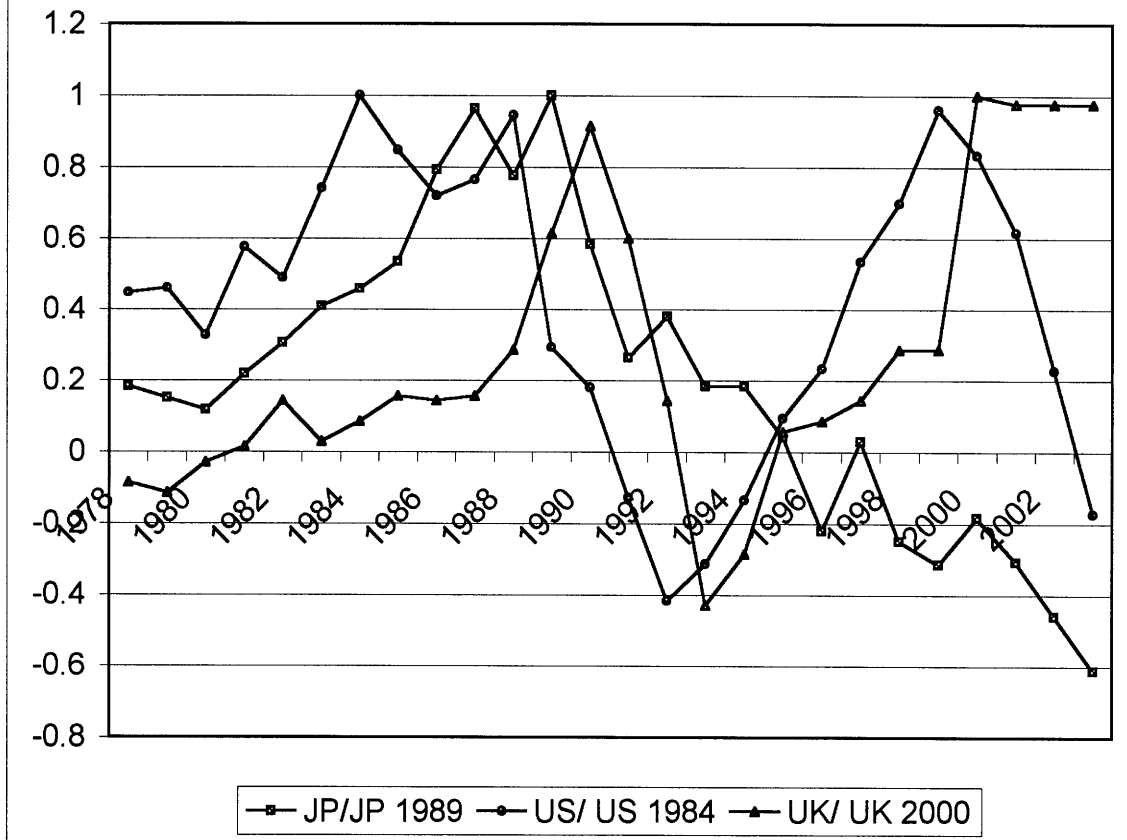
Commercial mortgage demand and its linkage with cap rate and mortgage rate were discussed in this thesis. In addition, commercial mortgage demand in US, UK and Japan is estimated and forecasted. The findings include:

1. Cap rate and mortgage interest rate can influence commercial mortgage demand. Commercial mortgage demand increases with cap rate but decrease with mortgage interest rate. The difference between cap rate and mortgage interest rate affects equity return, which in turn influences investor's investment and financing decisions.
2. Commercial mortgage flow is the sum of new loan origination and old loan retirement. It can be affected by both supply and demand. The spread between cap rate and mortgage rate moves commercial mortgage flow up and down. New construction, loan to value ratio, and stock of space describe the distribution of commercial mortgage flow.
3. New construction is the main source of new mortgage demand. Commercial mortgage demand increases with new construction. This is true in US, UK and Japan.
4. Existing properties are the source of second mortgage demand. They are also responsible for old loan payoffs. If the impact of old loan is greater than new loan, stock will have a negative sign in the commercial mortgage demand equation.
5. Commercial mortgage demand reaches its peak when new construction prospers and mortgage rate is relatively high. It drops to the bottom when new construction slows down and the mortgage rate is relatively low. In other words, commercial mortgage demand reaches its peak during a construction boom but hits the bottom during a construction bust.
6. Commercial mortgage demand in US, UK and Japan follows the same rule--- mortgage demand increases with cap rate and new construction but decreases with mortgage rate and stock. Commercial mortgage demand in US, UK and Japan reaches peaks during construction booms and drops to bottoms during construction busts. However, there is small difference among these countries. New construction is the dominant factor for commercial mortgage demand in US

and UK. In Japan, stock of construction is the most important factor for commercial mortgage flow to Japan real estate industry during the past decade.

7. Using the commercial mortgage demand model established in this thesis, one can predict the trend of commercial mortgage demand in US, UK and Japan in near term future. In next two years, US commercial mortgage demand will fall gradually, UK commercial mortgage flow will fall between £ 2503 million and £ 30060 million, and Japan commercial mortgage flow will be negative because the value of mortgages retired is greater than the value of mortgages originated in Japan. Exhibit 8-1 presents trend of commercial mortgage flow in Japan, UK and US. Notice that in recent years, commercial mortgage flow in Japan keeps on falling; in UK, it rises gradually; in US, it increases sharply.

Exhibit 8-1 Trend of commercial mortgage flow in Japan, US and UK



note: JP/JP 1989 means Japan commercial mortgage flow in year t divided by Japan commercial mortgage flow in year 1989. Here commercial mortgage flow is the bank lending flow to Japan real estate industry. UK and Japan commercial mortgage demand value in years from 2001 to 2003 in Exhibit 8-1 is the average of predicted maximum demand and minimum demand of the two countries.

References

1. Brent W. Ambrose, High O. Nourse, *Factors influencing Capitalization Rates*, The journal of Real Estate Research, Spring, 1993.
2. Petros S Sivitanides; Rena C Sicitanidious; *Exploring Capitalization Rate differentials across property types*, Real Estate Issues, Chicago, Dec 1997
3. Joseph H Martin, Mark W Sussman; *The twelve Rs: An overview of Capitalization rate derivation*, The appraisal Journal, Chicago, Apr. 1997
4. Richard B. Gold, *The nine percent solution*, Real Estate Issues, August 1996.
5. Jeffrey D. Fisher, *Trends in Capitalization Rates from the NCREIF Database: Twenty years of Sold Properties*, Real Estate Finance, Spring 2000
6. William N. Kinnard, Mary Beth Geckler, John K. Geckler and Jake W. Delottie; *Capitalization Rates for Regional Shopping Centers: Anchor Department Stores VS. Mall Stores*, Real Estate Issues, August 1996
7. D. Richard Wincott, Kevin A Hoover and Terry V. Grisson, *Capitalization Rates, Discount Rates and Reasonableness*, Real Estate Issues, August 1996
8. G. Donald Jud and Daniel T. Winkler, *The Capitalization Rate of Commercial Properties and Market Returns*, The Journal of Real Estate Research, Volume 10, Number 5, 1995
9. Robert A. Steele, *Real Estate Investment Yield Linkage*, Real Estate Issues, Spring/Summer 1992
10. Janssen, Christian T L; McLeod Andrew; *Capitalization Rates and Return on Equity*, The Canadian Appraiser, Winnipeg, Winter 1994
11. Cymrot, Allen, *How low is a cap rate too low?* Real Estate Review, New York, Spring 1998
12. Froland Charles, *What Determines Cap Rates on Real Estate?* Journal of Portfolio Management, New York, Summer 1987
13. Young W. Chai, *A simplified Approach to Understanding Capitalization Rates*, Real Estate Issues, August 1996

14. Anonymous, Measuring Rates of Returns, *Real Estate Accounting and Taxation*, Boston, Winter 1988
15. Bradley, David M., *The Capitalization Rate, The discount Rate And Inflation*, The Appraisal Journal, Chicago, Apr. 1989
16. Lemieux William Jr., *Lower Interest Rates do not Imply Lower Capitalization Rates*, The Canadian Appraiser, Winnipeg, Spring 1994
17. Nourse Hough O., *The "Cap Rate", 1966-1984: A Test of the Impact of Income Tax Changes on Income Property*, Land Economics, Madison, May 1987
18. Josep L Pagliari Jr., Frederich Lieblich, Mark Shaner, James R Webb, *Twenty Years of the NCREIF property index*, Real Estate Economics, Bloomington, Spring 2001
19. Lesser Damiel H; Rubin Karen, *Rates of return on hotel investments*, Cornell Hotel and Restaurant Administration Quarterly, Ithaca, June 1993
20. Liteplo Donald N., *Cap rate valuation must yield to intensive multi-factor analysis*, Real Estate Review, New York, Fall 1994
21. Owens, Robert W, *An appraiser Examines four types of return rates*, Real Estate Review, New York, Winter 1996
22. Sirmans C F, Sirmans G Stacy, Beasley Ben T, *Income Property Valuation and the Use of Market Extracted Overall Capitalization Rates*, Real Estate Appraiser and Analyst, Chicago, Summer 1986
23. Wincott D. Richard, *Terminal Capitalization Rates and Reasonableness*, The Appraisal Journal, Chicago, Apr. 1991
24. Honnold, Keith L., *The link Between Discount Rates and Capitalization Rates: Revisited*, The Appraisal Journal, Chicago, Apr 1990
25. McCov Bowen H, *Capitalization Rate in a Dynamic Environment*, Real Estate Issues, Chicago, Fall 1990/Winter 1991
26. Ling David C, Smith Halbert C, *Linkage Among Capitalization Rates, Discount Rates and Real Estate Cycles*, Real Estate Issues, Chicago, Fall 1992
27. Gregory J Accetta, *Supporting Capitalization Rates*, The Appraisal Journal, Chicago, Oct. 1998

28. Sivitanides, Petros S, Sivitanidou Rena C, *Office Capitalization Rates: Why do they vary across metropolitan markets?* Real Estate Issues, Chicago, August 1996
29. Timothy Riddiough, *Real estate fiancé and investment lecture notes*, MIT Center for Real Estate, 2000
30. William C. Handorf, Sachlis J Minor, *Hurdle rate and investment analysis*, Real estate review, New York, Winter 1994
31. John Starke with Arlene Kierce Starke, *Mortgage lending and investing--- Understanding risks in a changing market*, Business One Irwin, Homewood, Illinois 60430
32. Marshall W. Dennis, *Mortgage lending fundamentals and practices*, Reston Publishing Company, Inc, Reston, Virginia
33. Norris, Daniel M.; Nelson Mark; *Real estate loan underwriting factors in the insurance industry*, Real Estate Finance, Boston, Fall 1992
34. Miles, Mike; Roberts John; Machi, Donna; Hopkins, Robert; *Sizing the investment markets: A look at the major components of public and private markets*, Real Estate Finance, Boston, Spring 1994
35. John B levy, *Spreads tighten as loan volume slows*, Barron's, Chicopee, August 7,2000
36. Snyderman, Mark P, *Update on commercial mortgage defaults*, The Real Estate Finance Journal, Boston, Summer 1994
37. Michael A Ervolini, *Trends in commercial mortgage loan pricing*, Commercial Lending Review, Boston, Winter 2000/2001
38. Luis C Mejia, *Availability of credit and loan default: A look at the mortgage supply cycle*, The Journal of Real Estate Research, Sacramento, July/August 1999
39. Susan Hudson-Wilson; George J Pappadopoulos, *CMBS and the real estate cycle*, Journal of Portfolio Management, New York, Winter 1999
40. Giliberto Michael, *A performance benchmark for commercial mortgages*, Real Estate Finance, Boston, Winter 1997
41. Miles Mike, *Where is the money the cheapest*, Real Estate Finance, Boston, Winter 1995

42. Stevenson Bruce G, *Cyclical capital flows and the cycles of losses in commercial real estate*, Real Estate Review, New York, Summer 1995
43. Charles D Horner, *Investor Criteria for choosing between mortgage loans from portfolio and CMBS conduit lenders*, The Real Estate Finance Journal, Boston, Spring 2001
44. Pollack Bruce, *Commercial real estate loan underwriting revisited*, The Real Estate Finance Journal, Boston, Jan.1992
45. Merrill Lynch Global Real Estate, Presentation to MIT, April 20,2001
46. Brent W. Ambrose, John Benjamin and Peter Chinloy, *Credit restriction and the market for commercial real estate loans*, Real Estate Economics, 1996 V24 page1-22
47. Shilton Leon, Teall John, *Option-based prediction of commercial mortgage defaults*, The Journal of Real Estate Research, Sacramento, Spring 1994
48. Levy John B, *Loan demand strengthens as rate drops*, National Real Estate Investor, Atlanta, May 1995
49. Levy John B, *Will loan originations maintain upward climb?* National Real Estate Investor, Atlanta, Feb 1996
50. Allan Sloan, *Why mortgage rates aren't falling*, Newsweek, New York, May 21,2001
51. Levy John B, *Low interest rates aid loan production trend*, National Real Estate Investor, Atlanta, Jan.1996
52. Levy John B, *Lenders fighting for each new loan offering*, National Real Estate Investor, Atlanta, Aug 1994
53. Jean Sherman Chatzky, *Grab a great rate*, Money, New York, Dec 1998
54. Gail Liberman, *Client strategies---Jumbo, Please: The jumbo market is becoming increasingly competitive for wealthier borrowers with excellent credit*, Financial Planning, New York, Apr.1,2000
55. John B. Levy, *The ground floor: Wall street firms team up to sell big mortgage issues*, Barron's, Chicopee, Jun2,1997
56. Phil Britt, *What's hot what's not in mortgage lending*, America's Community Banker, Washington, May 1997

57. John B. Levy, *Whole-loan, CMBS volumes continue upward rampage*, Barron's, Chicopee, Jun,1998
58. Rose Clarence C, *Real estate investment refinancing*, Real Estate Finance, Boston, Winter 1992
59. Angelo R Mozilo, *Returning to a purchaser-dominated market*, Mortgage Banking, Washington, Oct. 1999
60. Arsan Noyan, Poindexter, Eugene, *Revisiting the economics of mortgage refinance*, Arlington, Winter 1993-1994
61. Lisa Valentine, *Risk-based pricing on the way?* American Bankers Association, ABA Banking Journal, New York, May 1999
62. Judy Feldman, *Rate opportunity*, Money, New York, March 2001
63. John B Levy, *Mortgage rates stable: Low leverage loans in demand*, National Real Estate Investor, Atlanta, May 1998
64. Adam Tempkin, *Mortgage refinance boom has originators working weekends*, The Investment Dealers' Digest, IDD, New York, Jan 15, 2001
65. Anonymous, *Move away from fixed rate mortgages*, Credit Management, Stamford, Apr.1999
66. Levy John B, *Lenders tightens spreads to be competitive*, National Real Estate Investor, Atlanta, July 1994
67. Chen Andrew H, Ling David C, *Optimal Mortgage Refinancing with stochastic interest rates*, Areuea Journal, Bloomington, Fall 1989
68. Anne Tergesen, Amy Dunkin, *It's time to refinance again*, Business Week, New York, November 2,1998
69. Levy John B, *Loan demand suffers as interest rate rise*, National Real Estate Investor, Atlanta, Apr. 1989
70. Pallarito Karen, *Rising interest rates blamed for falling returns at REITs*, *Modern Healthcare*, Chicago, Feb 27, 1995
71. Raymond Y C Tse, John Raftery, *The effects of money supply on construction flows*, Construction Management and Economics, London, Jan/ Feb 2001
72. Saft Stuart M, *Reducing the risks of construction lending*, The Real Estate Finance Journal, Boston, Spring 1999

73. Luskin Martin, *Real estate construction financing: The pitfalls of the tri-party agreement*, The Real Estate Finance Journal, Boston, winter 1996
74. Frank J. Fabozzi and David P. Jacob, *The handbook of commercial mortgage backed securities, second edition*, published by Frank J. Fabozzi Associates in conjunction with Normura Securities international, Inc
75. Garner, Ronald L., *Consider Economic Cycles in Real Estate Investing*, Pension World, Atlanta, Sep 1987
76. Foort Hamelink, Martin Hoesli, Bryan MacGregor, *Inflation hedging versus inflation protection in the U.S. and the U.K.*, Real Estate Finance, Boston, Summer 1997
77. Miles Mike, Mahoney Joseph, *Is commercial real estate an inflation hedge? Real Estate Finance*, Boston, Winter 1997
78. Jeffery J Cohen, *Investment cycle linked to economy*, National Real Estate Investor, Atlanta, Feb. 2001.
79. Rodin, Neal L; *Approaches for real estate development and investment for the 1990s*, The Real Estate Finance Journal, Boston, Summer 1991
80. Etter, Wayne E., *Financial feasibility analysis for real estate development*, The Journal of Real Estate Development, Boston, Summer 1988.
81. Mark Fogarty, *Construction loan outlook: Healthy*, US Banker, New York, Nov. 1999
82. 8. Anonymous, Trends in US construction, 1995 to 1999, Construction Review, Washington, Fall 1994.
83. Axler, Michael M, *Valuing development projects*, The Real Estate Finance Journal, Boston, Winter 1994.
84. William C Handorf, J. Minor Sachlis, *Commercial real estate investment, financial leverage, and interest rates*, Real Estate Review, New York, Winter 2000
85. Maris, Brian A.; Elayan, Fayez A; *Capital structure and the cost of capital for untaxed firms: the case of REITs*, Areuea Journal, Bloomington, Spring 1990
86. Allen, Marcus T, *Capital structure determinants in real estate limited partnerships*, The Financial Review, Tallahassee, Aug 1995

87. Gau, George W; Wang, Ko; *Capital structure decisions in real estate investment*, Areuea Journal, Bloomington, Winter 1990
88. Barry Vinocur, *The ground floor: How much debt is too much for a property company? It depends on how you measure it*, Barron's, Chicopee, Nov. 30, 1998
89. Wilson, David Jr., *Elements of the capitalization rate*, The Canadian Appraiser, Winnipeg, Fall 1991.

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