Real Estate Finance
11.431/15.426J
Fall 2002

Problem Set 2
Due (end of lecture or beginning of recitation)

Chapter 9
(Hint: see problems 9.5 and 9.6 at the end of Ch.9, and their answers worked out in the back of the book on pp.854-855. I suggest using Excel to answer these problems.)

1) A common type of real estate investment vehicle used by institutional investors is known as a "unit fund" or "open-end" commingled fund (CREF). Investors can put capital into, and withdraw capital out, of such funds on the basis of the appraised value of the assets in the fund, which are regularly and frequently reappraised. Thus, if the assets are appraised at $10 Million, and you invest $100,000, you have a 1% share, entitling you to 1% of the net cash flow and proceeds from sales within the fund. Now consider a "passive" buy-and-hold strategy over a 3-year period in such a fund. Suppose you invest $200,000 in the fund at the end of 2000, to obtain two "units" (i.e., shares). During 2001 the fund pays out $6,000 per unit from net rental income, and at the end of 2001 is reappraised to a net asset value of $102,000 per unit. During 2002 the fund again pays out $6,000 per unit in net rental income, but the appraised value at the end of 2002 falls to $95,000 per unit. Finally, during 2003 the fund pays out only $5,000 in net income and at the end of 2003 the assets of the fund are sold in the real estate market and liquidated for net cash proceeds of $93,000 per unit. Use your calculator or a computer spreadsheet (the latter will be faster and more reliable) to answer the following questions reporting your answers to the nearest basis point.
(a) Assuming appraised value accurately reflects market value ("opportunity cost") of the assets at intermediate points in time, what are the period-by-period <u>total</u> returns for each of the 3 years the investment was held (2001, 2002, 2003)?
(b) Based on these period-by-period returns, what is the <u>arithmetic</u> average annual total return during the 3-year holding period of the investment (2001-2003)?
(c) What is the <u>geometric</u> average annual total return during that holding period?
(d) What is the <u>internal rate of return</u> (IRR, per annum) of the investment over its 3-year holding period?
(e) Which of these three average returns over the 3-year life of the investment tells <u>exactly</u> what the profit would have been per original dollar invested if the investor had taken the cash paid out plus proceeds from liquidating his units at the end of each year and used all (and only) this cash to immediately purchase units (and fractions thereof) to reinvest in the fund again for the following year (i.e., such that there was no cash flow into or out of the investment except at the beginning and end of the 3-year period)?

2) Suppose that the investor in the above problem at first was cautious, buying only one unit initially at the end of 2000. Then a year later she felt at the end of 2001 that the market would continue to rise, so she made an additional capital contribution sufficient to buy one more unit at that time. Then, shocked by the bad performance of the fund in 2002, she decided to cash out one of her units at the end of 2002. (Assume the fund would purchase the unit back for its appraisal-based value as of the end of 2002.)
(a) Calculate the investor's IRR.
(b) Why is this IRR lower than that calculated in the previous problem, and also lower than the mean period-by-period return to the fund over the 2001-2003 period?
(c) Why is the time-weighted HPR a better measure for judging the performance of the fund, and the IRR a better measure for judging the performance of the investor in this case?
(d) Under what conditions would the IRR not be a fair measure of the investment decision makers ex post performance?

Chapter 1

NOI Level of existing buildings & New buildings Compared to the CPI
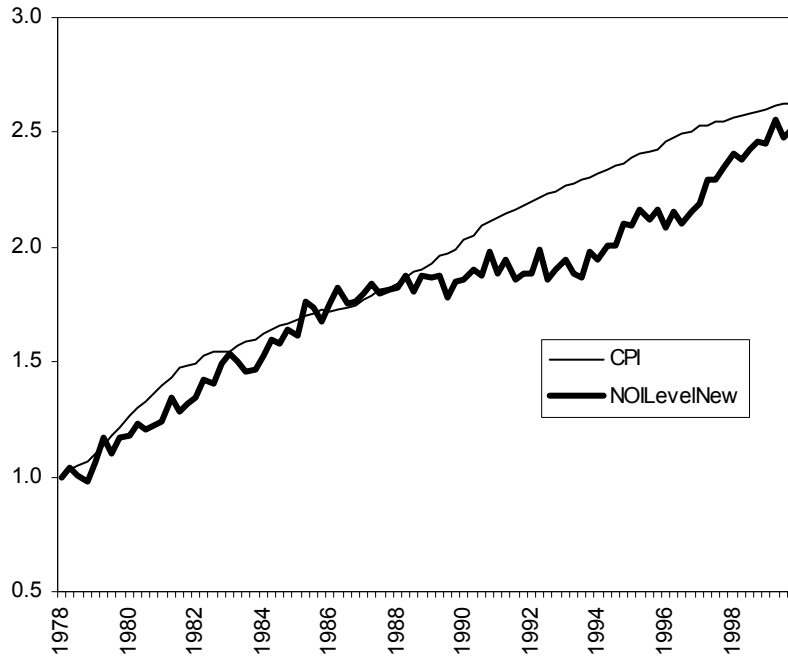
Source: NCREIF Index & authors estimates

3) The picture above is similar to Exhibit 1-9, discussed in Study Question 1-6 in Chapter 1 of the text. The chart traces out the actual historical pattern of US commercial property net rents, as compared to inflation. More precisely, the exhibit shows the CPI as in Exhibit 1-4, along with an index of the level of the net operating income (NOI) earned by new properties owned by members of the National Council of Real Estate Investment Fiduciaries (NCREIF). These represent large, "Class A" commercial properties in major MSAs throughout the US, and the index depicts how the NOI changed for the average property, controlling for the effect of property age (i.e., it does not show the effect of property depreciation). When the two lines in the Exhibit are roughly parallel, they are growing at about the same rate, indicating constant real rents. When the NOI line is falling below the CPI line (a widening gap), that indicates declining real net rents, that is, net rent after subtracting out inflation. Study the answer to question 1-6 in your text, and modify that answer to fit the above picture. No essay is required, but please draw a revised version of the supply & demand chart showing supply & demand in the early 80s, the early 90s, and the late 90s.

Cap Rates (OARs) for Commercial Property
As of 3rd Quarter, 1994
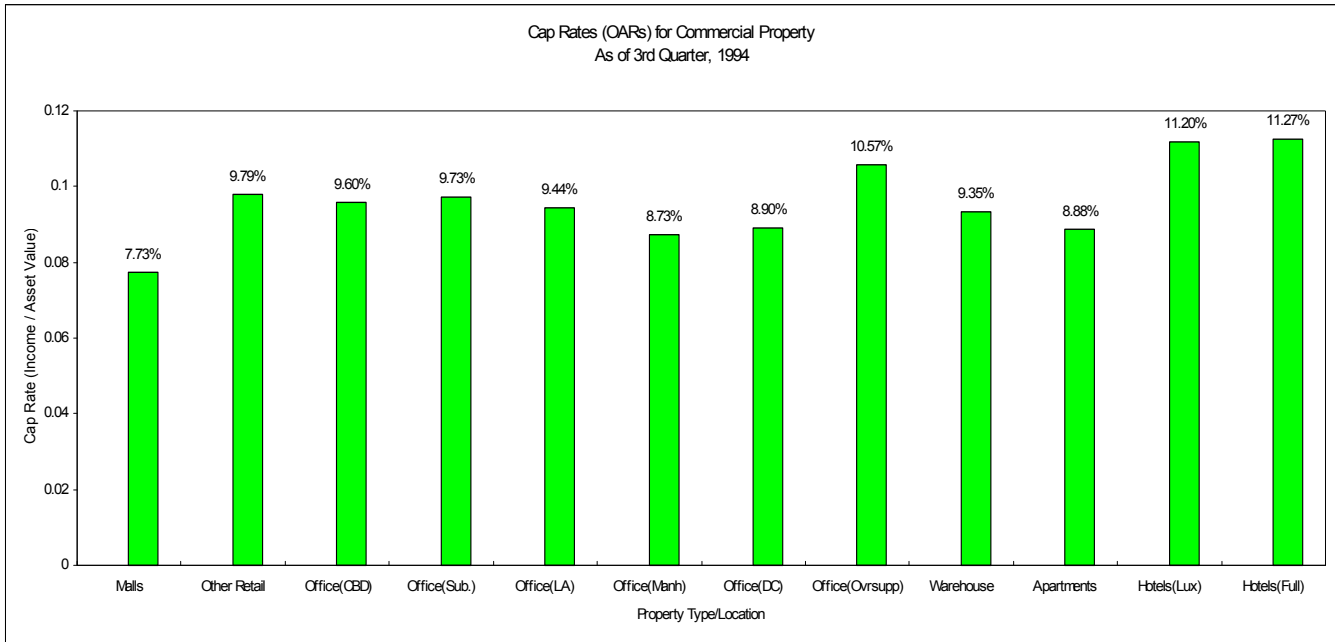
4) The chart above reproduces Exhibit 1-6 from Chapter 1. Use the definition of the "cap rate" (income/value) and the data on prevailing market cap rates for early 1994 presented in Exhibit 1-6 to estimate the value of: (a) A typical Los Angeles office building which has a net operating income of $10 Million per year? [Note: This method of valuing income property, dividing the current net income by the cap rate, is known as "direct capitalization", a widely used "shortcut" valuation method.] (b) A typical Manhattan office building which has a net operating income of $10 Million per year?. (c) Why do you suppose the Manhattan building is worth more? [Hint: Think about land scarcity, the geographical form of Manhattan, and the resulting implications for long-run real rental growth.] (d) Suppose that climate differences, plus union/mafia control of the construction industry in New York City, combine to make construction costs higher in New York than Los Angeles. Could this explain the higher price for the $10,000,000/yr net rent building in Manhattan as compared to Los Angeles?

Chapter 2

5) Suppose user demand for space in a certain market grows from 4 to 5 MSF at $10/SF net rent. Assuming property market cap rates remain constant at 10%, show on a four quadrant diagram like Exhibit 2-4a the short and long-run effects of this change in user demand. [Hint: you can answer qualitatively, or recognize that specific quantitative answers will depend on the shapes and slopes of the curves (i.e., the elasticities) in each quadrant. You can also use the "blank" 4-quadrant diagram attached at the back of this assignment. This requires some "trial-&-error". I recommend using an erasable pencil and a ruler, or else import this file into Word and use the Word Draw Utility "rectangle tool" to find the answer.]

6) Suppose investor demand for real estate assets grows in the sense that prevailing cap rates (OARs) in the property asset market fall from 10% to 8%. Assuming usage demand remains constant in the space market, show on a four-quadrant diagram like Exhibit 2-4b the short and long-run effects of this change in investor demand. [Hint: see the hint for the previous problem.]

Chapter 4

7) Suppose the most productive use of a particular site is as a warehouse serving internet-based retail distributors. The warehouse can generate revenues of $1,000,000 per year. The operating expenses for the warehouse (other than net rent) are $300,000 per year. The building can be built and equipped for $5 million, which can be paid for by a perpetual loan with interest of $500,000 per year. According to the residual theory, how much is the land parcel worth in terms of annual land rent?

8) Consider the simple monocentric city model of "Circlopolis" in Chapter 4. Suppose that the population of the city was 2,000,000 (instead of 1,000,000 in the book) and that the Circlopolites preferred to live at a density of 4 persons per acre (instead of 2/acre in the book). Everything else is the same as in Chapter 4 ($500/yr/acre agricultural land value, $250/mi/person/yr transport costs, housing construction costs of $50,000 equating to $5000/yr annualized, with one person living per house). (a) What is the area (in Mi^2) of the city? [Hint: there are 640 acres per square mile.] (b) What is the city's radius (in miles)? (c) What is the rent gradient (per mile, per acre) in this city? (d) What is the annual property rent per acre for built property at the edge of the city? (e) What is the annual property rent per acre at the center of the city? (f) What is the annual location rent premium per acre in the center? (g) What is the annual location rent premium *per person* in the center? (h) What is the annual transportation cost *per person* at the edge of the city?

9) Use the simple monocentric model described in Chapter 4 to answer the following questions: (a) Show analytically (i.e., develop an algebraic formula that shows, based on the location value economic principles of the monocentric city) that the value of the central location must fall if either transport costs per mile fall or if the overall city density falls, holding all else constant (namely, population and income). (b) Now suppose a doubling of real income per capita is associated with a doubling of demand for urban land (e.g., people want houses on 2-acre lots instead of 1-acre lots, &/or they want more parks and golf courses), but only a 30% increase in the real cost of transportation per mile (because, e.g., even though the higher income has increased the value of people's travel time, the higher income also allows faster and more comfortable means of transport , and because some of the real income increase is caused by, or results in, technological and infrastructure improvements that enhance the per mile efficiency of transportation and/or reduce the need for physical movement via telecommunications advances). In this circumstance, in what direction and by what percentage will the value of the location rent in the center of the city change as a result of the doubling of real income (holding city population constant)?

Chapter 5

10) Consider two undeveloped land sites. At site "A" the best current construction project is a warehouse that would cost $5,000,000 to build (exclusive of land cost) and would then generate annual net rents of $700,000, that are expected to grow at 3% per year. At site "B" the best current construction project is an office building that can generate net rents of $1,000,000, projected to grow at 1% per year, with construction cost of $8,000,000. Suppose investors buying built properties (that is, properties already developed and in operation) require an initial annual return (in the form of current net income) of 10% minus the expected annual growth rate in the net income, as a percent of the investment cost. For example, they would want an initial yield or "cap rate" of 7% for the warehouse (10%-3%=7%). Suppose the land value for both sites is $4,000,000. On which of these sites (A, B, both, or neither) is it currently profitable to undertake construction? Show your reasoning.

11) Suppose site acquisition costs typically equal 40% of total development project costs, and 60 years typically elapse between major redevelopment on a given site. By what percent per year does the property value grow *less than* the growth rate of the location value of the site?

Blank 4-Quadrant Diagram… (Use Word or PowerPoint "Draw" utility to manipulate function lines & rectangle.)

Rent $

Asset Market:
Valuation

Space Market:
Rent Determination

D

D

R*

Price $

P*

Stock (SF)

Q*

C*

Asset Market:
Construction

Space Market:
Stock Adjustment

Construction (SF)