

Commingled Real Estate Funds (CREFs)

Objective: The objective of this assignment is to familiarize students with some of the issues associated with commingled real estate funds (CREFs). In particular, we will examine performance related concerns and possible solutions.

Assignment: Download the real estate data from my website (CREF2005.xls) and use the downloaded spreadsheet to answer the following questions. Please highlight your answers in **yellow** and turn in a hard copy of your results. ***This is an individual assignment.***

1. Seasonality in CREF Returns: In the United States, the most frequently used index of private commercial real estate performance is that produced by the National Council for Real Estate Investment Fiduciaries (NCREIF¹). NCREIF reports income, capital and total returns disaggregated by sector and region based on a sample of institutional-owned properties valued at \$73billion as at 1999 Q2. The data is available on a quarterly basis. Many of the properties are only valued on an annual basis, creating seasonality in the data. The lack of high frequency data is a particular problem in real estate, the high cost of appraisal precluding frequent reporting.

Does seasonality still exist in the NCREIF data given recent revisions to the index? More specifically, is there a fourth quarter "effect" (dummy variable for the fourth quarter is statistically significant) with respect to NCREIF quarterly returns? To see whether the NCREIF total return series contains quarterly seasonality, regress the NCREIF total return (this is the dependent or Y variable) against 3 quarterly dummy variables – Dum_Qtr2, Dum_Qtr3, Dum_Qtr4 where

Dum_Qtr2 = 1 if Quarter is the 2nd Quarter and 0 otherwise

Dum_Qtr3 = 1 if Quarter is the 3rd Quarter and 0 otherwise

Dum_Qtr4 = 1 if Quarter is the 4th Quarter and 0 otherwise

Following is an example of the resulting spreadsheet:

YYYYQ	NCREIF			
	TotalReturn	Dum_Q2	Dum_Q3	Dum_Q4
19781	2.90%	0	0	0
19782	3.06%	1	0	0
19783	3.39%	0	1	0
19784	5.89%	0	0	1
19791	3.81%	0	0	0
19792	4.32%	1	0	0
19793	4.75%	0	1	0
19794	6.19%	0	0	1

¹The website for NCREIF is <http://www.ncreif.org>

To construct the quarterly dummy variables, you can use an IF statement in Excel with the following syntax:

IF(logical_test,value_if_true,value_if_false)

An example of how to actually construct the 2nd quarter dummy variable using Excel follows:

	A	B	C	D	E
1					
2	YYYYQ	Year	Qtr	Dum_Q2	
3	19781	1978	1	0	=IF(C3=2,1,0)
4	19782	1978	2	1	=IF(C4=2,1,0)
5	19783	1978	3	0	=IF(C5=2,1,0)
6	19784	1978	4	0	=IF(C6=2,1,0)
7	19791	1979	1	0	=IF(C7=2,1,0)
8	19792	1979	2	1	=IF(C8=2,1,0)
9	19793	1979	3	0	=IF(C9=2,1,0)

To perform a regression in Excel, make sure the dependent Y variable (the total NCREIF returns in this problem) and the independent X variables (the quarterly dummy variables) are in columns that are adjacent to one another. Next, click on the **Tools** → **Data Analysis...** → **Regression** then click on the **OK** button. Using your cursor, highlight the appropriate column(s). If the highlighted column contains the data label in the first row, make sure to click on the **Labels** box. You can either click on an empty cell to put the resulting output in or put your output in a new worksheet that you have named.

2. Illiquidity of Real Estate and the Swapping of CREF Cash Flows: One strategy that some investment banks such as Morgan Stanley have proposed to CREF investors who wish to lessen their exposure in real estate but do not want to pay large transaction costs and do not want to turn a “paper” loss into a real loss through a sale of CREF units is to swap CREF returns for risk-free returns on either LIBOR or Treasury bills. Suppose that your firm, who holds units in a CREF, executes a real estate swap for a 3 month (90 day) Treasury bill. The swap was initiated in the second quarter of 1999; the real estate swap will last for 20 quarters ending in the first quarter of 2004.² The terms associated with the swap agreement are as follows:

Initial Appraised Value: \$175,000,000

Discount (of Appraised Value): 15%

Length of Swap (in quarters): 20 quarters (from 1999 Quarter 2 until 2004 Quarter 1)

²In hindsight, the swap was made over a period in which returns on capital appreciation were negative towards the latter half. The question to consider here is how would the party who wants to participate in real estate (receiver of real estate cash flows) have fared over this time period.

Spread over 3-month Treasury bill: .125%

Also,

Initial Notional Amount = Initial App Value * (100% - Discount of Appraised Value)

Discount Accretion Amount (per period) = (Initial Appraised Value * Discount of Appraised value)/Length of Swap

Discounted Initial Russell-NCREIF Capital Index Value =(Capital Index Val *(100%-Discount of Appraised value))

Number of Index Units = Notional Amount ÷ Discounted Capital Index Value

Discount Accretion (Percent %) = Discount ÷ Length of the Swap

Fill in the **yellow** highlighted areas in the “Receiver Template (Recv Ppty CF)” and the “Payer Template (Pays Ppty CF)”. The highlighted areas: 1) Show the net cash flows to Party A including all intermediate calculations on a spreadsheet, 2) Show the net cash flows to Party B including all intermediate calculations on a spreadsheet, and 3) Show the cash flows to the financial intermediary who set up the swap agreement including all intermediate calculations on a spreadsheet.

Is the swap a good deal for your firm? Was the swap, in hindsight, a good deal for the other party? Why or why not? If it is not a good deal, explain why it isn't. Plot out the NCREIF returns vs. 3-month Treasury bill.

3. Buy and Hold Strategy: Investing in CREFs relative to Equity REITs. In general, institutional investors typically will not engage in real estate swaps. The choice therefore frequently involves choosing between CREFs and REITs. Suppose that an institutional investor purchased 1 unit of NCREIF for \$100,000 in the first quarter of 1990. Assume that:

- The NCREIF unit appreciates or declines each quarter at the capital return portion of the NCREIF index. The income (dividend) paid on the NCREIF unit each quarter is equal to the income return on the NCREIF index.
- The income that the investor receives from his/her one unit is put in a bank account. Interest paid on that account is equal to the 90 day Treasury bill yield and is paid quarterly. Interest is compounded on a quarterly basis. Assume that income is paid at the end of each quarter on the value of the CREF unit at the beginning of each quarter.
- The investor can only sell his/her unit when the total quarterly NCREIF return (capital appreciation + income) is greater than the quarterly return on the 90 day Treasury bill

- A new institutional buyer of the investor's unit will only purchase a NCREIF unit if the **total** quarterly return on NCREIF (capital appreciation + income) is greater than the quarterly return on the 90 day Treasury bill for four successive quarters

Based on the preceding assumptions, when will the investor be able to sell his/her unit? What is the modified IRR for the NCREIF unit. If the investor had in lieu of purchasing a NCREIF unit, bought \$100,000 worth of the NAREIT's equity REIT composite index what would his/her Modified IRR be assuming the same holding period as the NCREIF investment and assuming quarterly payouts? In hindsight, would the investor have been better off buying NCREIF or NAREIT based solely on the MIRR? I have provided templates in the worksheet that you can use to answer the MIRR questions.

To calculate the MIRR, the future value of a lump sum formula is used as follows:

$$FV = PV (1 + MIRR)^T$$

where FV = future value of all cash flows. All cash flows are compounded forward at the rate on passbook savings or some safe rate (we use the 90-day return).

PV = present value of cash outlays. If the investment is staged in, say, investing \$1,000 in Period 0 and another \$1,000 in Period 1, these cash outlays are discounted back to present at the opportunity cost of funds. The opportunity cost of funds is defined as the rate of return on the next best opportunity.

T = Holding period; time to sale of your investment

Example: Suppose that an investor invests \$2000 in the current period (t_0) and another \$2000 at the beginning of the next period (t_1). Cash flows on the 5 year project are \$700 (t_1), \$750 (t_2), \$775 (t_3), \$800 (t_4) and \$850 (t_5). The terminal value of the project is \$2500 (t_5). If the investor did not invest in this project, the rate of return associated with his next best opportunity is 9%. Assume that the risk free rate is 3% and the risk free rate remains stationary over the five year period. Cash outlays (investments in the project) are assumed to be made at the *beginning* of each period. Cash inflows are assumed to be received at the *end* of each period. What is the modified IRR?

r_f	0.03							
OppCost	0.09							
	Cash			Discounted	Cash			Compounded
Time	Outlay	1+OpCost	PV Factor	Outflows	Inflows	1 + r_f	FV Factor	Inflows
0	2000			2000				
1	2000	1.09	0.917431	1834.86	700			940.74
2					750	1.03	1.03000	978.58
3					775	1.03	1.06090	953.15
4					800	1.03	1.092727	900.41
5					3350	1.03	1.1255088	3350
5	T	Totals	PV	\$3,834.86			FV	\$7,122.88
			MIRR	0.131829936				

4. Replicating NCREIF Return or NCREIF Volatility using NAREIT and 3 Month Treasury Bills: The low volatility of NCREIF returns due to smoothing as a result of appraisal bias raises the question of whether one can construct a portfolio consisting of quarterly NAREIT returns and the return on 3 Month Treasury Bills. The former has higher returns (volatility) while the latter has lower returns (volatility) relative to NCREIF returns (volatility) on average. Using the “4a. Comparing Yields” template in the worksheet that you downloaded, calculate the optimal weights for NAREIT (w_{NAREIT}) and the 3 month T-Bill (w_{TBill}) for the following two scenarios using quarterly return data from the first quarter of 1982 through the first quarter of 2004:

Scenario 1: Calculate the minimum variance portfolio using NAREIT and T-Bill (quarterly) returns subject to the condition that the return on the resulting portfolio is equal to the mean of the NCREIF returns. Assume that the investor is fully invested and that no short sales are allowed. Mathematically,

$\text{Min } \sigma^2 = w^T \Sigma w$	Minimize variance of portfolio
s.t. $w^T \mathbf{1} = 1$	Subject to fully invested ($w_{NAREIT} + w_{TBill} = 1$)
$w_{NAREIT} \geq 0$	No short sale on NAREIT
$w_{TBill} \geq 0$	No short sale on T-Bill
$w^T R = \text{Average } (R_{NCREIF})$	weighted portfolio return equals mean of NCREIF

Scenario 2: Calculate the maximum portfolio return using NAREIT and T-Bill (quarterly) returns subject to the condition that the standard deviation on the resulting portfolio is equal to the standard deviation of the NCREIF returns. Assume that the investor is fully invested and that no short sales are allowed. Mathematically,

$\text{Max } R_p = w^T R$	Maximize the return on the portfolio
s.t. $\sigma = (w^T \Sigma w)^{.5} = \sigma_{NCREIF}$	Subject to standard deviation of portfolio
$w^T \mathbf{1} = 1$	Fully invested ($w_{NAREIT} + w_{TBill} = 1$)
$w_{NAREIT} \geq 0$	No short sale on NAREIT
$w_{TBill} \geq 0$	No short sale on T-Bill

where w^T is a 1x2 row vector of weights (w_{NAREIT} and w_{TBill})

Σ = 2x2 variance-covariance matrix

$\mathbf{1}$ = is a 2x1 column vector containing 1 in each row

R = is a 2x1 column vector containing the average returns (\bar{R}_{NAREIT} and \bar{R}_{T-Bill})

To calculate the optimum weights you will need to use matrix multiplication (the mmult function in Excel) and the solver³ function (**Tools** → **Solver...**) in Excel. To calculate the mean, variance, and covariance use the average, var and covar functions in Excel.

³If you do not find solver in the **Tools** submenu of Excel, go to **Tools** → **Add-Ins...** → **Solver** and then click the OK button. When you pull down the **Tools** submenu again, you should now see the Solver option.

Alternatively, you can calculate these statistics using the Data Analysis option located under the **T**ools submenu⁴.

Example: Suppose you wanted to see what the optimum weights (w_{Asset1} and w_{Asset2}) are from minimizing the variance of a portfolio containing 2 assets, Asset1 and Asset2, subject to $w_{\text{Asset1}} + w_{\text{Asset2}} = 1$, $w_{\text{Asset1}} \geq 0$, $w_{\text{Asset2}} \geq 0$, and $E(R)_{\text{Asset1}}w_{\text{Asset1}} + E(R)w_{\text{Asset2}} = E(R)_{\text{Asset3}}$. In setting up your initial equations, assume $w_{\text{Asset1}} = .5$ and $w_{\text{Asset2}} = .5$. Remember that this is what we are solving for. Also assume that

	Asset3	Asset1	Asset2
Mean	5%	12%	4%
StDev	4%	15%	1%
Covariance			
Asset3	16%	36%	-16%
Asset1	36%	225%	4%
Asset2	-16%	4%	1%

Your spreadsheet should be similar to the following spreadsheet

	A	B	C	D	E	F
1		Asset3	Asset1	Asset2		
2	Mean	5%	12%	4%		
3	StDev	4%	15%	1%		
4						
5	Covariance					
6	Asset3	16%	36%	-16%		
7	Asset1	36%	225%	4%		
8	Asset2	-16%	4%	1%		
9						
10	Scenario 1: Optimize wts such that Rp = Avg(Z)					
11			Asset1	Asset2		
12		Weights	0.5	0.5		
13		Return	Covar	Covar		Weights
14	Asset1	12%	225%	4%		0.5
15	Asset2	4%	4%	1%		0.5
16						
17		Portfolio	Portfolio			Total
18		Return	StDev			Weights
19		0.0575	0.764853			1

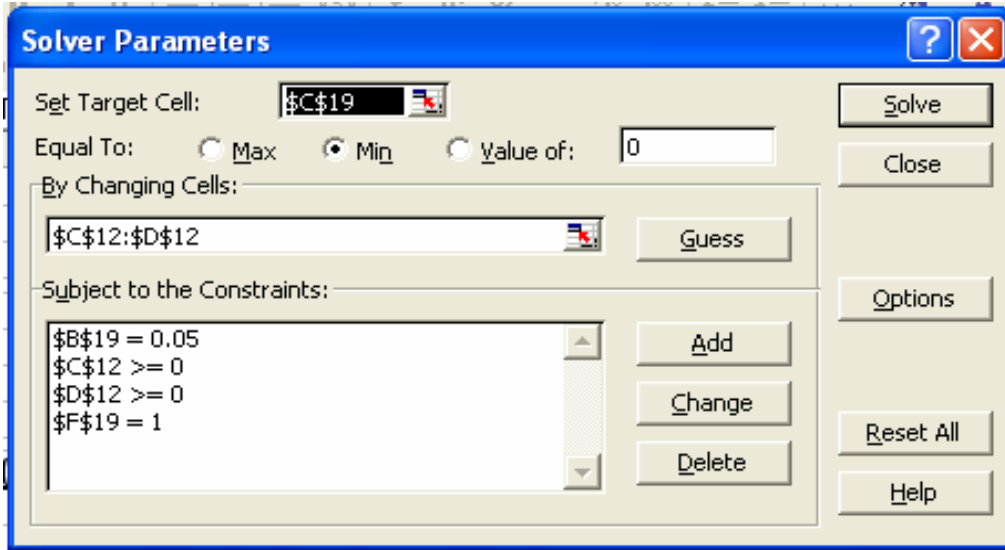
where Portfolio Return =MMULT(B14:B15,C12:D12)

Portfolio StDev =SQRT(MMULT(MMULT(C12:D12,C14:D15),F14:F15))

Total Weights =F14+F15

⁴If you do not find **Data Analysis**... in the **T**ools submenu of Excel, go to **T**ools → **Add-Ins**... → **Data Analysis** and then click the OK button. When you pull down the **T**ools submenu again, you should now see the **Data Analysis**... option.

Next, use Solver to minimize the portfolio variance subject to the specified conditions as follows:



Clicking the **Solve** button after you have finished setting up the equations would yield the following optimal weights:

	A	B	C	D	E	F
1		Asset3	Asset1	Asset2		
2	Mean	5%	12%	4%		
3	StDev	4%	15%	1%		
5	Covariance					
6	Asset3	16%	36%	-16%		
7	Asset1	36%	225%	4%		
8	Asset2	-16%	4%	1%		
10	Scenario 1: Optimize wts such that $R_p = \text{Avg}(Z)$					
11			Asset1	Asset2		
12		Weights	0.434783	0.5652		
13		Return	Covar	Covar		Weights
14	Asset1	12%	225%	4%		0.43478
15	Asset2	4%	4%	1%		0.56522
17		Portfolio	Portfolio			Total
18		Return	StDev			Weights
19		0.05	0.669466			1

Is it possible to replicate the NCREIF returns using NAREIT and the 3 month Treasuries? Can we obtain the same NCREIF average return with a lower portfolio variance? Can we obtain the same NCREIF volatility with a higher portfolio return? Please explain. Using the optimal portfolio weights from Scenario 1 and Scenario 2, calculate the resulting portfolio returns under each Scenario and plot the return on these portfolios against the NCREIF returns over time.