MEASURING REAL ESTATE RETURNS

by John McMahan

The entry of pension funds into real estate has generated increased concern about the accurate measurement of real estate returns. The impetus comes primarily from plan sponsors desiring to report asset performance on a consistent, portfolio-wide basis in order to forecast asset/liability relationships accurately. As most assets are securities, there is strong interest in measuring real estate returns on a reasonably comparable basis, combining both current income and changes in asset value to reflect the "total return" of/on investment.

The Measurement Problem

There is little problem in measuring current income from real estate. Income is received on a monthly or quarterly basis, typically comprising 50% or more of total return. In fact, traditional real estate analysis relies exclusively on current income in measuring investment return.

The more difficult problem is to forecast changes in current income and to measure appreciation (depreciation) in the value of the asset over the holding period. Appreciation is particularly difficult as the real estate market does not clear on a daily basis and may not clear (as in the case of overbuilt markets) for a period of years. The true performance of real estate investments, therefore, is not really known until the assets are sold and cash proceeds received. In the case of pension fund investors, the problem is further compounded by the pooling of assets in vehicles such as closed-end funds and limited partnerships where assets may not be liquidated for a period of years, or open-end funds where, conceptually, the market is never cleared.

This measurement problem is of particular concern to real estate investment advisors who must select assets for pension fund portfolios many years in advance of the clearing process. The advisor requires an analytical

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technique that can compare candidate investments to each other and to overall portfolio investment objectives. The technique must take into consideration the initial capital requirements of the investment, varying cash flows over the holding period, and the termination value of the asset at the end of the holding period.

Analytical Solutions

The analytical technique used by most advisors is some form of discounted cash flow analysis (DCF) in which annual flows and anticipated terminal values are compared with the initial capital investment. The discounted cash flows may be compared against a predetermined minimum investment standard (target rate; hurdle rate; etc.) in which a positive Net Present Value (NPV) indicates an acceptable investment. More commonly, discounted flows are translated into an Internal Rate of Return (IRR) which is then compared to a minimum percentage standard.

In recent years, there has been considerable criticism of the use of DCF analysis. Interestingly, the criticism originates not so much from pension managers, but rather from the real estate community. The intensity of the criticism often surprises one who has worked with discounted cash flow analysis for some time (I began applying the technique to real estate in 1961). Paradoxically, the critics generally do not offer an acceptable alternative except to substitute traditional measures of return such as pay back, cap rate, spendable return, etc. which present even more difficult conceptual problems.

The purpose of this paper is not to defend DCF analysis as there have already been many fine dissertations on the subject.[1] Rather, the paper attempts to build on the conceptual work of the past in order to establish overall levels of total return that an institutional investor might expect in today's market, as well as explore the sensitivity of certain key variables in terms of their impact on return. The conclusions of the paper are based on a research model which examines investment return characteristics under a variety of circumstances.

The Research Model

In developing a research model, I wanted to simulate an investment situation which:

- Represented the type of projects being acquired for institutional portfolios.
- Did not have a disproportionate relationship between land and building.
- Had a relatively straightforward construction program.
- Had a relatively simple lease structure.

A suburban office building was ultimately selected as most closely meeting the desired criteria. Other alternatives were considered, but rejected. Residential buildings are seldom purchased by institutional investors; shopping centers have overly complicated lease structures; inndustrial buildings are not complicated enough; hotels are more of a business than real estate. CBD office buildings were rejected due to the complicated nature of the construction program.

A development project was selected in order to explore the entire spectrum of return from the creation of the asset through disposition. It also allows more flexibility in sensitivity analysis since a broader range of variables can be tested.

The effect of leveraging was included because advisors are increasingly considering the use of leverage in developing portfolios, and it is timely to reflect on the impact of this strategy on investment return.

The effect of taxes was excluded from the analysis because most institutional investors are tax exempt, and also because I wanted to observe how variables interact in an environment unencumbered by the distortions of tax policy.

The investment position of both the developer and the investor was considered in order to measure the incremental return inherent in the development process.

In summary, the analytical model involves a suburban office building under development, analyzed on a pretax basis utilizing both leveraged and unleveraged assumptions, as viewed from the position of both the developer and the investor.

Base Case Assumptions

With the parameters established, I then made a series of base case assumptions based on current market information (Winter, 1984).

The building is a two-story, 100,000 s.f. office building set on five acres of land costing $8.00 per s.f. Net rentable area is 92,000 s.f. with 350 parking stalls at grade. Construction is Type A with shell costs of $60.00 per s.f. and tenant finish of $15.00 per s.f. Architectural and engineering fees are 3% of construction costs; developer's overhead is 3% of land, construction costs, and A&E fees. Landscaping, property taxes, insurance, permits, leasing commissions, legal and miscellaneous interim costs are lump-sum items.

In terms of the timing of flows, the model assumes that construction is completed in the first year followed by a year to lease the space. It is further assumed that the building is 50% leased during the second year with the third year representing the first year of "stabilized" operations. The property is operated for 10 years and sold at the end of this period, based on a capitalization of Net Operating Income (NOI) for the following year.

The tenant mix is assumed to be 60% three-year and 40% five-year leases. Market rent in the stabilized year is $21.00 per s.f.; parking is $25 per month per stall. Operating costs are $5.00 per s.f. with the tenant paying any increases over the first year. At lease turn, it is assumed that 50% of the three-year and 25% of the five year tenants leave the building. Space vacated is assumed to remain vacant for three months on average, requiring payment of a 5% leasing commission upon releasing. Refurbishment costs are assumed to be $2.00 per s.f. for space occupied by tenants who stay and $6.00 per s.f. for space occupied by new tenants. The termination value is based on a 9.0% cap rate with 3% selling costs.

In the leveraged case, it is assumed that the project secures a $9,500,000 construction loan for two years at 15.0% and 2 points. In the first year, 50.0% of the loan is outstanding; 100.0% in the second year. Permanent financing is assumed to be available at the beginning of the stabilized year. The amount of the permanent loan is also $9.5 million with a term of 15 years (30-year amortization) at 13.0% for 1 point.

Market rent, parking, operating costs and refurbishment costs are inflated at an annual rate of 8% beginning in the fourth year.

A detailed description of the development and operation of the model appears in Appendix A.

Results Of The Research

Investment Returns

Table 1 summarizes nominal and real IRRs to both the developer and the investor on both a leveraged and non-leveraged basis.

Based on these results, we can make several observations. As more funds come into real estate and the amount of available product diminishes, many advisors have considered moving up the risk curve by integrating it into the development process. It has not been clear, however, whether this strategic move was worth the additional risk. This research would indicate that the incremental real return to the developer is almost double that of the investor and that such a move may indeed be worthwhile.

It is also clear from the analysis that the developer has much more to gain from leveraging than the investor. This is probably due to the fact that the developer's cash outflow is reduced in an earlier year than the investor, and the investor's cash outflow is greater, due to the development profit paid to the developer. The investor's small increase in return from leveraging would not seem to make it worthwhile, at least under current market conditions.

TABLE 1

Base Case Investment Returns

(IRR)

	Developer	Investor
Nominal Returns		
Non-leveraged	19.8%	14.4%
Leveraged	26.1	15.5
Real Returns		
Non-leveraged	13.2	7.0
Leveraged	18.5	7.9

Sensitivity Analysis

Another objective of the research program was to measure the sensitivity of major variables. Table 2 illustrates the results of this analysis. Sensitivity is calculated in terms of percentage change in IRR as compared with percentage change in the independent variable. Real returns were utilized for comparison purposes, calculated for both the developer and the investor.

Clearly, the most sensitive variable is market rent where even small changes in assumptions can have a major impact on returns. For example, a 10% reduction in rent may impact return by as much as 16.0% in the case of the developer and 28.1% in the case of the investor. This is most likely due to the relatively high "margin" of most real estate projects where so much (76% in the base case) of changes in revenue drop through to the bottom line. This reinforces the importance of rigorous market analysis before proceeding with a project and a strong leasing program throughout the holding period.

Also of importance to the investor is the purchase cap rate. A 10% increase can increase returns by over 20%. This would support the old axiom about "buying right" and suggests that more intensive acquisition negotiations can pay continuing benefits over the holding period.

For the developer, the next most sensitive variable is construction cost where a 10% increase can reduce return by as much as 6.9%. This argues persuasively for careful selection of the contractor and effective cost control during construction.

The investor and developer are both impacted by the sale cap rate assumption with a 10% increase in cap rate reducing return by 9.4% and 4.2% respectively. This would generally support the argument against utilizing a sale cap rate different than that prevailing at acquisition.

Changes in operating costs appear to have a greater impact on the investor (6.8%) than the developer (4.0%) but the impact for both parties is lower than anticipated. This is probably due to the fact that, today, office building operating expense is typically 25% of rental income and increases are generally absorbed by the tenant. The situation was no doubt quite different several years ago when operating expense was 35–40% and the landlord bore the full impact of increases in cost.

Land costs are likewise not as sensitive as previously thought, with return falling approximately 2% for every 10% increase in land cost. This might be somewhat different in the case of more intensive land projects, such as shopping centers, although my guess is that the market adjusts accordingly.

Returns also do not appear too sensitive to longer average lease term. This was measured in terms of the percentage of tenants signing five-year leases as compared with those on three-year leases. The percentage of five-year leases would have to shift by almost 20% to have a 1% impact on return to the investor.

TABLE 2

SENSITIVITY OF RETURNS TO CHANGES IN VARIABLES

Percent Change in Real Returns*

% Change in variable	Land Cost	Constr. Cost	Purchase Cap Rate	Market Rent	Oper. Costs	Lease Term	Turn-over	Sale Cap Rate	Vacancy
+30	−5.90	−19.26		+42.24	−12.38	+0.80	+2.44	−11.26	−0.77
+20	−3.98	−13.33		+28.93	− 8.12	+0.53	+1.63	− 7.95	−0.52
+10	−2.02	− 6.93		+14.91	− 4.05	+0.27	+0.82	− 4.23	−0.26
Base Case	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
−10	+2.06	+ 7.55		−16.04	+ 3.98	−0.27	−0.83	+ 4.85	+0.25
−20	+4.17	+15.82		−33.56	+ 7.90	−0.54	−1.65	+10.50	+0.51
−30	+6.34	+24.97		−53.01	+11.76	−0.81	−2.47	+17.17	+0.76
+30			+58.29	+72.97	−20.93	+1.45	+4.36	−25.20	−1.34
+20			+39.87	+50.16	−13.80	+0.97	+2.91	−17.76	− .90
+10			+20.50	+25.94	− 6.83	+0.48	+1.45	− 9.42	− .46
Base Case	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
−10			−21.88	−28.14	+ 6.69	−0.50	−0.70	+10.75	+ .44
−20			−45.43	−59.12	+13.24	−0.98	−2.94	+23.21	+ .88
−30			−71.09	−93.91	+19.67	−1.47	−4.41	+37.85	+1.33

* Non-leveraged; pre-tax

Tenant turnover was measured by varying the percentage of tenants who stay at the time of lease turns. A 10% increase in the number of tenants staying, as an example, increases the developer return by .82%. Likewise, the model is not very sensitive to increased vacancy at the time of lease turns.

In summary, the general categories of sensitivity are:

	Developer	Investor
Highly Sensitive:		
	Market Rent	Market Rent
	Construction Cost	Purchase Cap
	Sale Cap	Sale Cap
Moderately Sensitive:		
	Operating Costs	Operating Costs
	Land Cost	
Largely Insensitive:		
	Turnover	Turnover
	Lease Term	Lease Term
	Vacancy	Vacancy

The bottom line of the sensitivity analysis is that a developer who does a thorough job of analyzing the market and controlling construction and operating costs has a relatively high probability of achieving pro forma returns. For investors, the research indicates the importance of market timing—buying and selling at the right time. It also reinforces the view that real estate is a managed asset and close attention to leasing strategy and the control of operating costs can pay big dividends over the holding period.

It is hoped that this research will contribute to a better understanding of how the various ingredients of a real estate project interact and impact investment return. Such an understanding should contribute to a more focused investment strategy and increased management attention to those variables that will most directly influence the attainment of a successful investment program.

APPENDIX A

Development And Operation Of The Model

The model was developed on an IBM PC, utilizing the Lotus 1-2-3 software program. Each of the steps in developing the model is discussed. Formula symbols are explained in the text and on the exhibits, as well as being indexed in Exhibit 1. The base case assumptions discussed previously are summarized in Exhibit 2.

EXHIBIT 1
Formula Index

AE	Total Architecture & Engineering Costs	OHF	Developer Overhead Fee (%)
AEF	Architecture & Engineering Fee (%)	P	Total Parking Cost
B	Total Building Cost	PA	Parking Area (# stalls)
BC	Building Cost (per s.f.)	PC	Parking Cost (per stall)
BR	Building Revenue	PR	Parking Revenue
DCAP	Disposition Cap Rate	PT	Points (amount)
GBA	Gross Building Area	PTF	Points (%)
GR	Gross Revenue	R	Refurbishment Costs
i	Interest Rate	RR	Replacement Reserve
IC	Interest on Construction Loan	S(3)	Space Occupied by Tenants on Three-Year Leases
L	Total Land Cost	S(5)	Space Occupied by Tenants on Five-Year Leases
LA	Land Area	SCAP	Cap Rate in Stabilized Year
LC	Land Cost (per s.f.)	SCOM	Sales Commission
LCOM	Leasing Commission	SE	Sales Expense
LCOMF	Leasing Commission Fee (%)	SP	Sales Proceeds
LS	Landscaping Cost	T	Loan Term
MBR	Market Building Rent	T(3)	Percentage of space leased to 3-year tenants
MFS	Market Refurbishment Costs for Staying Tenants	T(5)	Percentage of space leased to 5-year tenants
MFL	Market Refurbishment Costs for Leaving Tenants	TI	Tenant Improvements (per s.f.)
MGT	Mortgage Loan	TL	Percentage of space occupied by leaving Tenants
MOE	Market Operating Expense	TOE	Total Operating Expense
MPR	Market Parking Rent (month)	TR	Tenant Reimbursement
n	Amortization (years)	TRL	Tenant Refurbishment Expense for Leaving Tenants
NOE	Net Operating Expense	TRS	Tenant Refurbishment Expense for Staying Tenants
NOI	Net Operating Income	TS	Percentage of space occupied by staying tenants
NRA	Net Rentable Area	V	Percentage of revenue lost to vacant space
OH	Developer Overhead	Y	Lease Term

EXHIBIT 2
Assumptions

Space			
	Land (LA)		217,800 s.f.
	Building		
		Gross (GBA)	100,000 sf
		Net (NRA)	92,000 sf
	Parking (PA)		350 stalls
Unit Costs			
	Land (LC)		$8.00 per sf
	Building		
		Shell (BC)	$60.00 per sf
		Finish (TI)	$15.00 per sf
	Parking (PC)		$1,200 per stall
	A&E Fee (AEF)		3.0%
	Developer Overhead Fee (OHF)		3.0%
	Refurbish		
		Stay (MFS)	$2.00 per sf
		Leave (MFL)	$6.00 per sf
	Operating Expense (MOE)		$5.00 per sf
	Replacememt Reserve (RR)		1.0% Gr. Rev.
Finance			
	Construction		
		Amount	9,500,000
		Tera (T)	2 years
		Rate (i)	15.0%
		Points (PT)	2.0%
	Permanent		
		Amount	9,500,000
		Tera (T)	15 years
		Amortiz. (n)	30 years
		Rate (i)	13.0%
		Points (PT)	1.0%

Leasing				
	Tenant Mix			
		Three (T(3))	60.0%	
		Five (T(5))	40.0%	
	Stay			
		Three (TS)	50.0%	
		Five (TS)	75.0%	
	Leave			
		Three (TL)	50.0%	
		Five (TL)	25.0%	
	Months Vacant		3	0.5
	Market Building Rent (MBR)		$21.00 per sf	
	Market Parking Rent (MPR)		$25.00 per stall	
	Leasing Commission (LCOM)		5.0%	
Sale				
	Stabilized Cap Rate (SCAP)		9.0%	
	Disposition Cap Rate (DCAP)		9.0%	
	Sales Expense (SE)		3.0%	
Stabilized Year			3	
Holding Period			10 years	
Inflation Rate			8.0%	
Convention			End of Year	

Project Cost Estimate

The first step in developing the model is to estimate the amount of initial capital required. This is accomplished by extending the various space/cost assumptions and applying lump-sum amounts where an extension is difficult or superfluous. All of the costs are first-year except for leasing commissions which occur in the second year. (See Exhibit 3).

EXHIBIT 3

Project Cost Estimate

Year			1	2
Activity			Construction	Leasing
Project Cost Estimate				
Land (L)			$1,742,000	$
Construction				
	Building (B)		7,380,000	
	Parking (P)		420,000	
	Landscaping (LS)		100,000	
	Architecture & Engineering (AE)		237,000	
	Developer Overjead (OH)		296,382	
		Total	8,433,382	
Interim				
	Taxes		50,000	
	Insurance		25,000	
	Permits		45,000	
	Leasing			200,000
	Legal		30,000	
	Misc.		25,000	
		Total	175,000	200,000
Total			10,350,782	200,000

Land (L):

(Land Area × Land Cost/s.f.) = Total Land Cost

(LA × LC) = L

(217,800 s.f. × $8 = $1,742,400

Building (B):

(Gross Building Area × Building Cost/s.f.) + (Net Rentable Area × Tenant Improvements/s.f.) = Total Building Cost

(GBA × BC) + (NRA × TI) =B

(100,000 s.f. × $60) + (92,000 s.f. × $15) = $7,380,000

Parking (P):

(Number of Parking Stalls × Cost/Stall) = Total Parking Cost

(PA × PC) = P

(350 × $1,200) = $420,000

Landscaping (LS):

Lump-Sum: $100,000

A&E (AE):

((Building + Parking + Landscaping) × A&E Fee) = Total A&E Costs

((B + P + LS) × AEF) = AE

((7,380,000 + $420,000 + $100,000) × .03) = $237,000

Developer Overhead (OH):

((Land + Building + Parking + Landscaping + A&E) × Developer Overhead Fee) = Total Developer Overhead

((L + B + P + LS + AE) × OHF) = OH

(($1,742,400 + $7,380,000 + $420,000 + $100,000 + $237,000) × .03) = $296,382

Interim costs are input on a lump-sum basis, again noting that leasing commissions will be paid in the second year. Total project costs are the sum of land, construction and interim costs.

Space Analysis

The next step is to establish the amount of space that is leased in each period. (See Exhibit 4.) With the exception of the lease-up and turning years, it is assumed that the building is 100% leased. It is then necessary to distinguish between three and five-year leases.

EXHIBIT 4

Space Analysis
(Square Feet)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Activity	Construction	Leasing	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Sale
Three Year Leases (S(3))													
Lease-Up Year		27,600											
Non-Turning Years			55,200	55,200		55,200	55,200		55,200	55,200		55,200	55,200
Turning Years													
Stay					27,600			27,600			27,600		
Leave					27,600			27,600			27,600		
Five Year Leases (S(5))													
Lease-Up Year		18,400											
Non-Turning Years			36,800	36,800	36,800	36,800		36,800	36,800	36,800	36,800		36,800
Turning Years													
Stay							27,600					27,600	
Leave							9,200					9,200	
Total Space Leased*		46,000	92,000	92,000	92,000	92,000	92,000	92,000	92,000	92,000	92,000	92,000	92,000

* Less three months vacancy on leaving tenant space.

Three-Year Leases

(Net Rentable Area × Percentage of Space Leased to Three Year Tenants) = Space Occupied by Three Year Tenants

(NRA × T⟨3⟩) = S⟨3⟩

(92,000 s.f. × .6) = 55,200 s.f.

Five-Year Leases

(Net Rentable Area × Percentage of Space Leased to Five Year Tenants) = Space Occupied by Five Year Tenants

(NRA × T⟨5⟩) = S⟨5⟩

(92,000 × .4) = 36,800 s.f.

In the lease-up year, these formulas are factored by an occupancy rate of .5% (50%).

For the years involving lease turns, the total amount of rentable space is multiplied by lease mix and the percentage of tenants staying (TS) or leaving (TL).

Three-Year Lease	**Five-Year Lease**
Tenants Staying:	
(NRA × T⟨3⟩ × TS) = S⟨3⟩	(NRA × T⟨5⟩ × TS) = S⟨5⟩
(92,000 s.f. × .6 × .5) = 27,600 s.f.	(92,000 s.f. × .4 × .75) = 27,600 s.f.
Tenants Leaving:	
(NRA × T⟨3⟩ × TL) = S⟨3⟩	(NRA × T⟨5⟩ × TL) = S⟨5⟩
(92,000 s.f. × .6 × .5) = 27,600 s.f.	(92,000 s.f. × .4 × .25) = 9,200 s.f.

If actual leases are in place at the time of the analysis, the terms of the leases should be substituted with appropriate staying and leaving assumptions.

Net Operating Income

Physical space and leasing relationships are translated into Net Operating Income (NOI) projections in Exhibit 5.

Market Rent

Market building rent (MBR) is forecast for the stabilized year at $21.00 per s.f. It is assumed that this rent level is the same in the leasing year. From the stabilized year forward, it is assumed that market rent increases at the 8% inflation rate given in the base case.

(MBR × 1.08)

Parking rent (MPR) was developed in a similar fashion.

(MPR × 1.08)

Gross Revenue

The gross revenue (GR) of most mixed tenancy office buildings tends to move in a "stepped" fashion—steady flows for two or three years followed by increases

EXHIBIT 5

Net Operating Income

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Activity	Construction	Leasing	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Sale
Market Rent													
Building (MBR)		$21.00	$21.00	$22.68	$24.49	$26.45	$28.57	$30.86	$33.32	$35.99	$38.87	$41.98	$45.34
Parking (MPR)		$25.00	$25.00	$27.00	$29.16	$31.49	$34.01	$36.73	$39.67	$42.85	$46.27	$49.98	$53.97
Gross Revenue (GR)													
Building													
Three Year		579,600	1,159,200	1,159,200		1,352,091	1,352,091		1,703,245	1,703,245		2,145,598	2,145,598
Stay					627,823			763,834			962,211		
Leave					458,811			550,928			694,011		
Five Year		386,400	772,800	772,800	772,800	772,800		1,051,386	1,051,386	1,501,386	1,051,386		1,544,831
Stay							684,070					973,581	
Leave							162,312					227,975	
Parking		52,500	105,000	113,400	122,472	132,270	142,851	154,279	166,622	179,952	194,348	209,895	226,687
Total		1,018,500	2,037,000	2,045,400	1,981,906	2,257,161	2,341,324	2,520,428	2,921,253	2,934,583	2,901,955	3,557,050	3,917,116
Operating Expense													
Market Operating Expense (MOE)		$5.00	$5.00	$5.40	$5.83	$6.30	$6.80	$7.35	$7.93	$8.57	$9.25	$10.00	$10.79
Total Operating Expense (TOE)													
Three Year		234,600	276,000	298,080	321,926	347,681	375,495	405,535	437,977	473,015	510,857	551,725	595,863
Five Year		156,400	184,000	198,720	214,618	231,787	250,330	270,356	291,985	315,344	340,571	367,817	397,242
Total		391,000	460,000	496,800	536,544	579,468	625,825	675,891	729,962	788,359	851,428	919,542	993,105
Tenant Reimbursement (TR)													
Three Year				22,080	22,963	25,754	53,569	41,804	32,443	67,481	52,661	40,869	85,007
Five Year				14,720	30,618	47,787	33,165	20,026	41,655	65,014	90,241	58,743	29,425
Total				36,800	53,581	73,541	86,734	61,830	74,098	132,495	142,902	99,612	114,432
Net Operating Expense (NOE)													
Three Year		234,600	276,000	276,000	298,963	321,926	321,926	363,730	405,535	405,535	458,196	510,857	510,857
Five Year		156,400	184,000	184,000	184,000	184,000	217,615	250,330	250,330	250,330	250,330	309,073	367,817
Total		391,000	460,000	460,000	482,963	505,926	539,091	614,060	655,865	655,865	708,526	819,930	878,674
Replacement Reserve (RR)		10,185	20,370	20,454	19,819	22,572	23,413	25,204	29,213	29,346	29,020	35,571	39,171
Net Operating Income (NOI)		617,315	1,556,630	1,564,946	1,479,124	1,728,663	1,778,819	1,881,163	2,236,176	2,249,372	2,164,410	2,701,550	2,999,271

(decreases) as leases turn.[2] The analytical challenge is to account for these flows in the year in which they occur. Fortunately, with new software programs such as Lotus 1-2-3, this is entirely possible, eliminating the need for the traditional "vacancy factor" approach in which an allowance is made against each year's gross revenue.

In all years except the lease-up year and turning years, the formula is: (Example: Year 3)

Three-Year Lease	**Five-Year Lease**
$(S\langle 3\rangle_3 \times MBR_3) = GR\langle 3\rangle_3$	$(S\langle 5\rangle_3 \times MBR_3) = GR\langle 5\rangle_3$
(55,200 s.f. × \$21) =	(36,800 s.f. × \$21) =
\$1,159,200	\$772,800

Again, for the lease-up year, the formula is factored by an occupancy rate of .5.

In turning years, the model should reflect the fact that building space will turn in a manner consistent with the original lease-up pattern (base year). This is accomplished in the case of staying tenants by assuming that one-half of the revenue in the turning year will be at the base year market rate and one-half will be at the prevailing rate for the turning year. For leaving tenants, it is necessary to further account for the months the space will be vacant (V) before it is released. In the base case, it is assumed that this period is three months (.5).

As an example, the formula for space occupied by three-year tenants, turning for the second time in the eighth year, is:

Staying Tenants

$(S\langle 3\rangle_5 \times TS_5 \times MBR_5 \times .5) +$
$(S\langle 3\rangle_8 \times TS_8 \times MBR_8 \times .5) = GRTS\langle 3\rangle_8$
(55,200 s.f. × .5 × \$24.49 × .5) +
(55,200 s.f. × .5 × \$30.86 × .5) =
\$763,834*

Leaving Tenants

$(S\langle 3\rangle_5 \times TL_5 \times MBR_5 \times .5) +$
$(S\langle 3\rangle_8 \times TL_8 \times MBR_8 \times .5 \times V) = GRTL\langle 3\rangle_8$
(55,200 s.f. × .5 × \$24.49 × .5) +
(55,200 s.f. × .5 × \$30.86 × .5 × .5) =
\$550,928*

Note again that the rent for leaving tenants is adjusted for a three months' vacancy period (.5).

Gross revenue for five-year leases is determined in a similar fashion, utilizing the appropriate tenant mix and staying/leaving assumptions.

Parking revenue is a product of the number of stalls (PA) times the monthly charge per stall (MPR), converted into an annual number. For example, in the third year:

$(PA_3 \times MPR_3 \times 12) = PR_3$
(350 × \$25 × 12) =
\$105,000

* Numbers may differ slightly from manual calculations due to the fact that the Lotus 1-2-3 program rounds to the 15th decimal.

No assumption was made regarding parking vacancy as it is generally negligible.

Operating Expense

Operating expenses flow in a somewhat different fashion than revenue because expenses are subject to change each year and tenant reimbursement may vary, depending upon the terms of each lease. There also may be a lag effect due to the billing of actual expense in the year succeeding the one in which they were incurred.

Total operating expense (TOE) is the product of the amount of space leased (S⟨3⟩ and S⟨5⟩) times the market expense (MOE) in the year in which it is incurred. For example, expenses for the fourth year in space occupied by three year tenants would be calculated as follows:

$(S\langle 3\rangle_4 \times MOE_4) = TOE_4$
(55,200 s.f. × \$5.40) =
\$298,080

Operating expenses for the lease-up period are assumed to be 85% of the expenses in the stabilized year. No adjustment is made for vacant space at least turn due to the relatively fixed nature of operating expenses.

Next, we must calculate the effect of tenant reimbursement. Today, many property managers bill tenants on the basis of projected expenses, with an adjustment made when actual expenses are known. This permits a simplifying assumption that expenses are reimbursed in the year in which they are incurred, with no lag effect.

This leaves the problem of the amount of tenant reimbursement (TR) and the year in which it flows. In non-turning years, this amount is determined by subtracting the base year expense from the current year expense. Again, space occupied by three year tenants in the fourth year:

$(TOE_4 - TOE_3) = TR_4$
(298,080 − \$276,000) =
\$22,080

Reimbursements are then netted out against total expenses to arrive at Net Operating Expense (NOE):

$(TOE_4 - TR_4) = NOE_4$
(\$298,080 − \$22,080) =
\$276,000

In turning years, the formula is factored by .5 reflecting the fact that reimbursements would only flow from the last six months of expiring leases. The first six months of operating expenses for new leases would not be reimburseable as the base increases to the prevailing market rate. As an example, in the fifth year, tenant reimbursement from space occupied by three year leases would be:

$(TOE_5 - TOE_3 \times .5) = TR_5$
(\$321,926 − \$276,000 × .5) =
\$22,963

Net operating expense would be calculated as in non-turning years.

$(TOE_5 - TR_5) = NOE_5$

$(\$321{,}926 - \$22{,}963) =$

$\$298{,}963$

Replacement Reserve

The replacement reserve is utilized to provide a reservoir of capital to handle the replacement of items too large to expense (e.g. elevators, roofs, HVAC systems, etc.).

There are many thoughts on how to handle replacement reserves. Perhaps the most rigorous approach is to calculate the anticipated life of each component and reserve sufficient annual funds to meet these obligations, assuming interest income on the reserved funds. Clearly, once a property has been acquired, this is the preferred approach.

In the pre-acquisition mode, however, I believe it is sufficient to use a surrogate, such as a percentage of assets, or gross revenue. For the purpose of this discussion, I have utilized a factor of 1% of annual gross revenue.

Net Operating Income (NOI) is then determined in Exhibit 5 by deducting net operating expense (NOE) and replacement reserves (RR) from gross revenue in the appropriate year: (Example: year 4)

$((GR_4 - (NOE_4 + RR_4)) = NOI_4$

$((\$2{,}045{,}400 - (\$460{,}000 + \$20{,}454)) =$

$\$1{,}564{,}946$

Cash Flow

Exhibit 6 transforms Net Operating Income into Cash Flow projections over the holding period of the asset by considering those expenses associated with lease turns and the proceeds from the sale of the asset at the end of the holding period.

Turning Costs

The first turning cost to consider is the cost of refurbishing the space. For staying tenants, this generally involves, at a minimum, cleaning the carpet and drapes, and may include painting. For space that is turning, it may be necessary to also rearrange partitions to suit incoming tenant needs.

The first step in calculating refurbishment costs is to estimate market costs of undertaking the required work, making a distinction between staying (MFS) and leaving (MFL) tenants. These estimates should then be inflated at the assumed inflation rate.

The amount of space turning is multiplied by the market refurbishment cost for the prevailing year. (Example: Three year lease, staying tenants, eighth year turn):

$(S\langle 3\rangle_8 \times TS_8 \times MFS_8) = R_8$

$(55{,}200 \text{ s.f.} \times .5 \times \$2.94) =$

$\$81{,}107$

Leasing commissions (LCOM) are calculated on leaving space only. As is the custom in most markets, the percentage commission (LCOMF) is applied against the market building rent (MBR) in the turning year for space occupied (S⟨3⟩) by leaving tenants (TL), multiplied by the lease term (Y). For example, space occupied by three year tenants, turning in the eighth year, would require leasing commissions as follows:

$(S\langle 3\rangle_8 \times TL_8 \times MBR_8 \times Y \times LCOMF) = LCOM$

$(55{,}200 \text{ s.f.} \times .5 \times \$30.86 \times 3 \times .05) =$

$\$127{,}743$

Total turning costs are the sum of tenant refurbishment costs and leasing commissions for each year.

EXHIBIT 6
Cash Flow

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Activity	Construction	Leasing	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Sale
Net Operating Income (NOI)		617,315	1,556,630	1,564,946	1,479,124	1,728,663	1,778,819	1,881,163	2,236,176	2,249,372	2,164,410	2,701,550	2,999,271
Turning Costs													
Market Refurbishment Costs													
Stay (MFS)		$2.00	$2.00	$2.16	$2.33	$2.52	$2.72	$2.94	$3.17	$3.43	$3.70	$4.00	
Leave (MFL)		$6.00	$6.00	$6.48	$7.00	$7.56	$8.16	$8.82	$9.52	$10.28	$11.11	$11.99	
Tenant Refurbishment Costs													
Stay (TRS)					64,385		75,099	81,107			102,171	110,345	
Leave (TRL)					193,156		75,099	243,321			306,514	110,345	
Total					257,541		150,198	324,428			408,685	220,690	
Leasing Commissions (LCOM)					101,407		65,712	127,743			160,920	96,552	
Total					358,948		215,910	452,171			569,605	317,242	
Sales Proceeds (SP)													
Nominal Cash Flow	(10,350,782)	417,315	1,556,630	1,564,946	1,120,176	1,728,663	1,562,909	1,428,992	2,236,176	2,249,372	1,594,805	33,443,254	
Deflation Factor	1.0000	1.0000	1.0000	1.0800	1.1664	1.2597	1.3605	1,4693	1,5869	1,7138	1.8509	1.9990	
Real Cash Flow	(10,350,782)	417,315	1,556,630	1,449,024	960,370	1,372,268	1,148,785	972,548	1,409,170	1,312,487	861,624	16,729,953	

Sale Proceeds

Having accounted for operating flows over the holding period, it is now necessary to establish a termination value for the asset. The most common approach is to utilize some capitalization of Net Operating Income, reflecting the fact that this is the way in which investment properties are sold. While this approach mixes the more traditional capitalization approach with DCF analysis, it seems to make sense in light of the universal use of the technique. Conceptually, the alternative would be to calculate the present value of the succeeding 10 years of holding, but, as the reader will quickly grasp, this is a circular process that would be unending.

In utilizing the capitalization approach, it is necessary to determine: (1) the year of NOI to capitalize; (2) the determinants of NOI; and (3) the appropriate capitalization rate.

In most markets, properties are sold on a capitalization of the next year's pro forma earnings (13th year in the base case), and this is the approach utilized.

Traditional determination of Net Operating Income includes deductions from gross revenue for operating expense, vacancy and replacement reserves. Operating expense and replacement reserves are appropriately calculated in the model, but it is necessary to make an adjustment for vacancy since the model targets vacancy to the turning year rather than the more traditional annual allowance. The simple vacancy allowance (V) should be the same as that generated by the turning year approach, which in the case of the model, is approximately 3%.

There is considerable controversy as to what capitalization rate to use. One body of thought maintains that the disposition capitalization rate (DCAP) should be lower than the stabilized capitalization rate (SCAP) in order to reflect the market appreciation of a mature property. Another school suggests raising the capitalization rate to reflect functional obsolescence.

Clearly, lowering the capitalization rate builds in a distortion of investment return and would not be appropriate. In utilizing a higher cap rate, however, the analyst is faced with the magnitude of the adjustment—to what extent would the market discount a property for technical obsolescence?

In light of this dilemma, I believe the preferable approach is to utilize the market capitalization rate prevailing in the stabilized year and assume that similar market conditions will prevail in the year of termination.[3] This approach, at least, neutralizes the impact of the sale cap rate assumption.

There is also the matter of sales costs such as sales commission, promotional brochure, advertising, seller's closing costs, etc. (SCOM). In the base case, I have assumed that these are 3% of the sales price.

The formula to establish termination value therefore becomes:

$$[(NOI_{\overline{13}}\,(GR \times V))\,/\,DCAP] \times [1.00 - SCOM] = SP$$
$$[(\$2{,}999{,}271 - (\$3{,}917{,}116 \times .03)\,/\,.09] \times [1.00 - .03] =$$
$$[(\$2{,}999{,}271 - \$117{,}513)\,/\,.09] \times [.97] =$$
$$[\$2{,}881{,}758\,/\,.09] \times .97 =$$
$$\$31{,}058{,}947$$

Nominal Cash Flow

The various flows in Exhibit 6 are then summed by year to arrive at nominal cash flow.

Real Cash Flow

Nominal cash flows are deflated at this point in order to eliminate any distortion brought about by the inflation assumption. It also allows comparison of results between inflationary periods.

The reader might ask "Why use an inflation assumption at all?—simply work with real numbers throughout." The problem is that this does not reflect the different ways in which inflation impacts independent variables in the management of a real property. The most extreme example is the leveraged case in which debt service payments continue in fixed terms while rental income, adjusted for inflation, is reported in nominal terms.

But there are also varying impacts in the non-leveraged case. Rents may increase at a different rate than operating costs. Tenant refurbishment costs may increase (decrease) at a different rate than rents (and leasing commissions based on rents). Tenant reimbursement is based on comparison with a base year in which costs could be substantially different (i.e. long lease). The solution, therefore, is to utilize an inflation assumption in developing the cash flow, but then to deflate the nominal cash flow to real terms.

Leveraged Analysis

Exhibit 7 explores the impact of leveraging on the base case based on current market conditions, Interest on the construction loan (IC) is determined by multiplying the amount of interest (i) times the average loan balance for the appropriate year. In the construction year, it is assumed that one-half of the loan is outstanding on average:

$$(MTG \times .5 \times i) = IC$$
$$(\$9{,}500{,}000 \times .5 \times .15) =$$
$$\$712{,}500$$

In the leasing year, it assumed that the entire balance of the loan is outstanding.

Points are determined by multiplying the percentage fee (PTF) times the total amount of the mortgage (MTG) for both the construction and permanent loans.

Debt Service is calculated by use of an annual constant (13.28X) taken from standard payment tables which is multiplied times the total amount of the mortgage.

EXHIBIT 7
Leveraged Analysis

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Activity	Construction	Leasing	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Sale
Non Leveraged Cash Flow	(10,350,782)	417,315	1,556,630	1,564,946	1,120,176	1,728,663	1,562.909	1,428,992	2,236,176	2,249,372	1,594.805	33,443,254	
Mortgage (MTG)	9,500,000												
Construction													
Points (PT)	190,000												
Interest (IC)	712,500	1,425,000											
Permanent													
Points (PT)	95,000												
Debt Service			1,261,600	1,261,600	1,261,600	1,261,600	1,261,600	1,261,600	1,261,600	1,261,600	1,261,600	1,261,600	
Payoff												8,968,000	
Nominal Cash Flow	(1,848,282)	(1,007,685)	295,030	303,346	(141,424)	467,063	301,309	167,392	974,576	987,772	333,205	23,213,654	
Deflation Factor	1.0000	1.0000	1.0000	1.0800	1.1664	1.2597	1.3605	1.4693	1.5869	1.7138	1.8509	1.9990	
Real Cash Flow	(1,848,282)	(1,007,685)	295,030	280,876	(121,248)	370,769	221,471	113,924	614,148	576,356	180,020	11,612,607	

Investor Analysis

Thus far we have been analyzing the position of the developer who retains ownership of the property throughout the holding period. Exhibit 8 looks at the situation of the investor who acquires the property at the end of the second year, based on a 9% capitalization rate of Net Operating Income (less 3% vacancy) in the third year. All other assumptions through the holding period are the same as in the developer case.

Internal Rate Of Return

IRR for all cases was calculated utilizing the Lotus 1-2-3 internal program. The Lotus formula for IRR is based on an iterative scheme, starting with an initial guess as to the answer. If convergence to within .00000001 does not occur within 20 iterations, the program disqualifies the result.

There has been considerable discussion about the problems of utilizing IRR in discounted cash flow analysis.[4] One problem is that the IRR process assumes that profit not recovered as cash before maturity is reinvested in the same project and earns at the IRR. Another problem is that alternating negative and positive flows after the investment year can result in multiple IRR returns.

Several approaches have been suggested to resolve these problems. The *modified internal rate of return* discounts all negative cash flows back to the investment year and positive cash flows forward to the termination year.[5] The *adjusted rate of return* approach offsets negative and positive flows, discounting the net result.[6] The *financial management rate of return* discounts cash flows at a weighted average of the IRR consisting of a "safe" rate and a "reinvestment" rate.[7]

Unfortunately, each of these approaches has its own set of technical problems, [8] which, when combined with the added complexity of the calculations, raises a serious question as to their usefulness. There is also some evidence that the impact of reinvestment assumptions has much less significance in reality than in theory.[9]

Rather than attempt to modify the IRR analysis, I believe that the most practical answer is to simply substitute the Net Present Value approach in those situations where the reinvestment rates are unrealistic or where there are significant shifts in cash flow from positive to negative. Fortunately, most institutional grade investments do not have these characteristics and therefore the IRR approach will handle the vast majority of situations that the analyst will face.

EXHIBIT 8
Investor Analysis

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Activity	Construction	Leasing	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Operations	Sale
Non-Leverage Cash Flow													
Nominal		(16,616,889)	1,556,630	1,564,946	1,120,176	1,728,663	1,562,909	1,428,992	2,236,176	2,249,372	1,594,805	33,443,254	
Real		(16,616,889)	1,556,630	1,449,024	960,370	1,372,268	1,148,785	972,548	1,409,170	1,312,487	861,624	16,729,953	
Leveraged Cash Flow													
Nominal		(7,116,889)	295,030	303,346	(141,424)	467,063	301,309	167,392	974,576	987,772	333,205	23,213,654	
Real		(7,116,889)	295,030	280,876	(121,248)	370,769	221,471	113,924	614,148	576,356	180,020	11,612,607	

NOTES

1. Traditional measures of return and their shortcoming are reviewed in James R. Cooper, *Real Estate Investment Analysis* (Lexington, Massachusetts: Lexington Books, 1974), Chapter 1 and Stephen E. Roulac, *Modern Real Estate Investment: An Institutional Approach* (San Francisco, California: Property Press, 1976, Chapter 19).

My personal belief is that most of the problems associated with the use of DCF analysis are a result of (1) poor models; (2) faulty assumptions; and/or (3) misunderstanding of results. No doubt there also have been cases of the purposeful misuse of the technique to prove one point or another.

2. Unless, of course, the leases are subject to an annual inflation adjustment.

3. Note that it is the "market" cap rate that is important, not the purchase price cap rate, which could vary considerably from market.

4. See Paul E. Wendt & Alan R. Cerf, *Real Estate Investment Analysis and Taxation*, Second Edition, (New York, McGraw-Hill, Inc., 1979) Chapter 3.

5. See James H. Lorie and Leonard J. Savage, "Three Problems in Rationing Capital", *Journal of Business* (October 1955).

6. See Donald J. Valachi, "More on the Arithmetic of Multiple and Imaginary Rates of Return", *Real Estate Appraiser and Analyst* (September–October 1980).

7. See Stephen D. Messner & M. Chapman Findlay, III "Real Estate Investment Analysis: IRR versus FMRR, *The Real Estate Appraiser*, Volume XXXXI, No. 4, July–August, 1976.

8. See Gaylon E. Greer and Michael D. Farrell, *Investment Analysis for Real Estate Decisions* (Chicago, Illinois: The Dryden Press, 1983, Chapter 15).

9. See C. Conrad Doenges, "The Reinvestment Problem, Practical Perspective," *Financial Management*, Spring 1972.