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**A New Look at Capitalization  
Rates and Capitalization Effects  
for Apartments and Commercial  
Properties: Evidence from  
Stockholm**

**This Working Paper replaces Working Paper No. 1,  
Estimating Capitalization Rates and Capitalization  
Effects in Stockholm**

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A decorative graphic consisting of a series of grey rectangular blocks of increasing height, arranged in a staircase pattern that ascends from the bottom left towards the top right.

## Arbetsrapport/Working Paper

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# **A New Look at Capitalization Rates and Capitalization Effects for Apartments and Commercial Properties: Evidence from Stockholm**

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## **ABSTRACT**

Using a data base of 403 property transactions in Stockholm in the early 1990s, we illustrate how a microdata base can be used to compute “constant quality” cap rate series and show a wide disparity between apartment and commercial series so calculated and series computed as simple averages of individual property cap rates. In the process, we find evidence of full capitalization of below-market financing in apartment prices. If the average cap rate series used in tests of the integration of U.S. real estate markets with capital markets are as distorted as the average Stockholm cap rate series, the usefulness of the tests is in doubt.

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# **A New Look at Capitalization Rates and Capitalization Effects for Apartments and Commercial Properties: Evidence from Stockholm**

## **Introduction**

Accurate (*constant quality*) capitalization rates are crucial to understanding property market developments. *Average* cap rates, in contrast, can vary significantly because the composition of properties within the average changes, because the lease structure of traded properties changes, or because the financing associated with traded properties changes. This study illustrates a method for estimating constant quality capitalization rates for apartments and commercial properties from about 400 Stockholm market transactions during the July 1990 to December 1992 period, when property markets were deteriorating following an unprecedented boom. Between 1986 and 1990, Stockholm real apartment prices rose by 70 percent; virtually that entire increase had been reversed by 1993. The cycle was even stronger for office buildings, as was generally the case worldwide. Between 1982 and 1989, Stockholm real office values tripled; again the increase was reversed by 1993 (Jaffee, 1994).

Many authors have analyzed average capitalization rates tabulated by the American Council of Life Insurance Companies (Froland, 1987; Nourse, 1987; and Ambrose and Nourse, 1993) and Jud and Winkler (1995) have recently analyzed series produced from the National Real Index panel. The purpose of these studies has been, largely, to test the degree to which real estate markets are integrated with capital markets. Our purpose, in contrast, is to show how data from individual properties in a data base can be utilized to produce a “constant quality” cap rate series that is superior to a simple average of the individual property cap rates.

Estimation of the apartment cap rates is especially interesting because subsidies equivalent to below-market financing have been attached to most apartments constructed in Sweden since the late 1970s. These subsidies are fully “assumable” by purchasers. Thus the estimation contains a test of the capitalization of below-market financing. We find that the present or cash-equivalent value of below-market financing is fully capitalized into apartment

prices, just as Berger, Englund, Hendershott and Turner (BEHT, 1997) find that Swedish subsidies for owner-occupied housing were fully capitalized into those prices. Earlier research on capitalization of below-market financing for apartments supports both substantial overcapitalization (Gau, 1986) and substantial undercapitalization (Sirmans and Sirmans, 1986 and 1991).

The paper is organized in the following way. The next two sections discuss the general determinants of cap rates and the specific effect of below-market interest rate financing or interest rate subsidies. We then present raw average cap rates and the characteristics of the key data series used in our analysis. Last, we report our estimation results, compute constant-quality cap rates and then compare our estimated constant-quality cap rates with the raw average cap rates. The quality adjustment matters. To illustrate, between the second halves of 1991 and 1992, the average cap rate for apartments rose by nearly three percentage points, while the constant quality cap rates rose by only three-quarters of a point. And between the second halves of 1990 and 1991, average commercial cap rates fell by two percentage points while the constant-quality rates rose by two and a half points.

### **Capitalization Effects and Capitalization Rates**

Property values are the present values of the future net rents the properties are expected to generate. As is well known, if these rents are expected to grow at a constant rate  $g$  and  $i$  is the appropriate discount rate, then the ratio of current rent to value,  $R/V = \text{cap}$ , is

$$\text{cap} = i - g. \tag{1}$$

Both  $i$  and  $g$  can be divided into two parts. The nominal discount rate is the sum of the risk-free rate and the appropriate risk premium,  $p$ , and the growth rate in rents is the general expected inflation rate plus the expected rate of real rental growth,  $a$ . Netting expected inflation from the risk-free rate to obtain the real risk-free rate,  $r$ , we can rewrite (1) as

$$\text{cap} = r + p - a. \quad (1)$$

Property market equilibrium can be defined by the combination of the vacancy rate equaling the normal or natural rate, the expected real appreciation rate equaling the negative of the depreciation (and maintenance) rate, and expectations that these conditions will hold continuously in the future. When these conditions hold, value will equal replacement cost (Hendershott, 1996). Changes in the equilibrium cap rate will occur in response to changes in either the real interest rate or the property risk premium.

Of course, the markets are not continuously in equilibrium. Empirically, the expected growth rate in real rents,  $a$ , and thus the observed cap rate, has a strong cyclical pattern.<sup>1</sup> As a property market switches from boom to bust, the impending excess supply of space becomes increasingly obvious and  $a$  becomes very negative. As a result, prices plummet and cap rates jump. Around the cyclical trough, real rent expectations shift from declines to increases ( $a$  goes from below to above normal) because vacancies and rents must return to normal. This causes prices to surge relative to rents and thus the cap rate to fall.<sup>2</sup> The period we are examining in Stockholm, mid1990 to end1992, is one in which the property market was switching from boom to bust and capitalization rates were rising.

To illustrate consider the trough of the cycle. At this point assume that real rents are expected to rise at rate  $a' > a$  for  $N$  periods, at which point equilibrium is reached. The cap rate at the trough is then (see Appendix A):

$$\text{cap} = (r+p-a)/[X(1-Z) + Z] \quad (2)$$

where  $X = (r+p-a)/(r+p-a')$  and  $Z = 1 - (1+a')^N/(1+r+p)^N$ . With  $a=a'$ , the cap rate is at its normal or equilibrium value. The greater is  $a'-a$  and the larger is  $N$ , the lower is the observed cap rate relative to the equilibrium rate. That is,

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<sup>1</sup> Using data contained in the National Real Estate Index panel data set, Jud and Winkler (1985) show a general decline in cap rates from late 1985 (beginning of data set) to early 1989 and then a sharp rise through the end of 1992 (end of data set).

the further are rents below equilibrium, the greater must the cap rate be to capture their expected future rise. At the peak,  $\mathbf{a}' < \mathbf{a}$ , and the cap rate is above its equilibrium value.

The expected real rental growth rate varies with property type, across location, and over time, owing largely to properties of different type in different locations being at different stages of the cycle. The risk-free rate and the risk premium also vary over time and the latter can vary by property type. Thus, we write

$$\mathbf{R}/\mathbf{V} = \mathbf{cap} = \phi(\text{type, location, time}). \quad (3)$$

Equation (3) must be modified owing to the below-market interest rate subsidies attached to many Stockholm apartments. Between 1975 and 1989, most newly constructed apartments obtained financing on 95 percent of construction costs at an initial interest rate of 2.4 to 3.4 percent, depending on the precise rules for a specific year, with the rate scheduled to rise by approximately 0.25 percent annually until the market rate was reached (see Appendix B). Given market interest rates in the 10 to 14 percent range, the present value of the subsidy could exceed 50 percent of the value of the property). These subsidized loans were fully assumable by subsequent buyers. The tax reform of 1991 increased the first-year guaranteed interest rate from 2.7 percent to 3.4 percent and raised the rates applicable to the existing stock.

Subsidized loans should affect cap rates because the transactions price ( $\mathbf{P}$ ) for apartments with subsidies should exceed the value of the property without subsidies ( $\mathbf{V}$ ) by the value of the subsidy ( $\mathbf{SUB}$ ), and this component of price need not be supported by rental income. If we let  $\lambda$  be the ratio of the present value of subsidies remaining to the transactions price and  $\gamma$  be the parameter indicating what fraction of the subsidy value is capitalized into the price, then

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<sup>2</sup> A danger for the stability of property markets is that investors will extrapolate the sharp cyclical rebound in the economy and rents into the future far beyond when the economy and property markets have fully recovered (Hendershott, 1996).

$$\mathbf{P} = \mathbf{V} + \mathbf{SUB} = \mathbf{V} + \gamma\lambda\mathbf{P} \quad (4)$$

or  $\mathbf{V} = (1 - \gamma\lambda)\mathbf{P}$ . By definition,  $\lambda$  is zero for all commercial buildings and for apartments constructed prior to 1977.

Substituting for  $\mathbf{V}$  in equation (3), taking the natural log, and solving for the price term, we have

$$\ln\mathbf{P} = \ln\mathbf{R} - \ln\phi - \ln(1 - \gamma\lambda). \quad (2')$$

where the last term is approximately  $\gamma\ln(1-\lambda)$  for values of  $\gamma$  near unity (between 0.5 and 2.0). The key empirical hypotheses are a positive unity coefficient on  $\ln\mathbf{R}$  and a negative unity coefficient on  $\ln(1-\lambda)$ . Capitalization rates for unsubsidized properties can be calculated as  $\exp(\ln\phi)$ . For properties with a subsidy equal to  $\lambda$ , this cap rate should be multiplied by  $1/(1-\gamma\lambda)$ . A constant-quality cap rate for properties with a given fractional subsidy can be measured by specifying a fixed set of the variables determining  $\phi$ .

### The Data

The data base consists of 403 transactions in the Stockholm region during the mid1990-end1992 period. These data were collected by the Chartered Surveyors as a test for the general assessment of residential property in 1994. Our data base includes only apartment and commercial properties.<sup>3</sup> We have computed the ratio of floor space in apartment use to space in apartment and commercial use. Based upon this measure, we have divided the sample into “pure” apartments (over 90 percent apartment usage), pure commercial (over 90 per-

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<sup>3</sup> The basic data base excludes transactions through equity shares or in combination with sale of firms or business activity and between relatives. We have furthermore excluded seven hotels, industrial buildings and small retail buildings such as gas stations and permanent newsstands. This exclusion also comprises of properties with more than one building, as well as transactions with a price below 300,000 SEK, as these properties probably are meant to be used as individual private houses. Finally, we have deleted four apartment houses that were sold the year after construction or rehabilitation because their price may not yet fully reflect the subsidies (see BEHT, 1997).

cent commercial use) and mixed (the rest).<sup>4</sup> On average, the area of the mixed property sales is 71 per cent apartment space.

Table 1 shows the mean “gross” cap rates and number of sales for the three property types for our five semi-annual periods. As can be seen, while the apartment and commercial

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<sup>4</sup> All but one of the commercial properties is 100 per cent commercial (the one is 95 per cent). Only 42 per cent of the “pure” apartment properties is 100 per cent apartment (another 22 per cent are between 95 and 100 and the remaining 36 per cent are between 90 and 95).

**Table 1 Average Cap Rate and Number of Cases by Type of Property and Semiannual Period**

Time Period	Apartment		Mixed		Commer		Sum
	Cap Rate	#	Cap Rate	#	Cap Rate	#	
II 1990	<b>0.113</b>	38	<b>0.084</b>	35	<b>0.106</b>	14	87
I 1991	<b>0.118</b>	38	<b>0.105</b>	31	<b>0.087</b>	18	87
II 1991	<b>0.133</b>	34	<b>0.125</b>	38	<b>0.086</b>	12	84
I 1992	<b>0.136</b>	42	<b>0.124</b>	33	<b>0.131</b>	8	83
II 1992	<b>0.162</b>	26	<b>0.131</b>	25	<b>0.172</b>	11	62
Sum		178		162		63	403

cap rates are roughly equal both initially and at the end of the period, both rising by five to six and a half percentage points, the intraperiod movements are far different. During the first year, the rates move in opposite directions rising (apartment) and falling (commercial) by two points. During the second year, the apartment cap rate rises by another three percentage points, while the commercial rate increases by nearly eight and a half points. The cap rate for the mixed property moves much like the apartment cap rate. The average number of transactions per period for the three property types are 36, 32, and 13.

We account for property type with a dummy variable for the share of space that is in apartment use, a separate density variable (ratio of building space to land area) for commercial properties, and the apartment subsidy variable. We account for location with 18 location dummies, and we have time dummies for the five semi-annual periods of our sample to capture cyclical impacts generally and separate time dummies for apartments only to allow cap rates to evolve differently for the two types.

Table 2 shows the distributions of the densities (ratio of square meters of building space to square meters of lot size) of the three property types. The distribution of the commercial properties is far more extreme than that of the apartment and mixed (two-thirds apartments) properties. Two-fifths of commercial has floor space less than one-half of the land area (indicating single story retail), versus about an eighth for apartments and mixed; while about a sixth of commercial and an eighth of mixed has a density of over 3.5 (sug-

gesting high rise offices), versus only two percent of apartments. Moreover, the mean density of commercial building sold varies over time, averaging 1.5 but ranging from 0.66 in 922, when most sales were presumably low rise retail, up to 2.08 in 911.

**Table 2 Densities for the Three Property Types**

Density	Apartment	Mixed	Commercial	All
Class	Percent	Percent	Percent	Percent
- 0.5	<b>15</b>	<b>12</b>	<b>41</b>	<b>18</b>
0.5 - 1.5	<b>59</b>	<b>33</b>	<b>21</b>	<b>43</b>
1.5 - 3.5	<b>25</b>	<b>41</b>	<b>21</b>	<b>31</b>
3.5 +	<b>2</b>	<b>13</b>	<b>17</b>	<b>9</b>
Sum	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

We calculate the value of the interest rate subsidies as the present value of below-market after-tax cash flows over the life of the loan. Denoting the market interest rate by  $i$ , the guaranteed rate by  $i_t^*$ , and the loan value by  $L_t$ , we compute the subsidy value at time  $t_0$  as

$$SUB = \sum_{t=t_0}^T \frac{Z_t L_t}{(1+i)^{t-t_0}}$$

where  $Z_t = i - i_t^* - 0.01$  if greater than zero and is otherwise zero, and  $L$  evolves according to standard amortization schedules for housing loans.  $T$  is defined as the first date when  $i^*$  reaches  $i-0.01$ . At this date the house drops out of the subsidy system and is not eligible to future subsidies even if  $i$  were to exceed  $i^* + 0.01$ . Here, expected future market interest rates and subsidy rules are assumed to be those existing at time  $t_0$ .<sup>5</sup> This housing is owned by both municipal housing authorities and private companies; the former formally pay no taxes and the latter effectively do not.

We measure in two alternative ways. The most straight-forward measure is the rate on 70% LTV five-year fixed interest loans, which is the only mortgage rate available over this period. But the subsidy includes two difficult to measure option values that this measure ignores. The correct market interest rate is that on 95% loans. Uncertainty in house prices implies that households will, on occasion, be able to increase their well being by giving up their house and defaulting on their loan. The subsidy measure using the market rate on 70% LTV loans will understate the correct subsidy measure by the extra value of the default option on 95% loans. This option is worth considerably less in Sweden than in the U.S. because Swedish lenders have recourse to other household assets and future labor income, limiting default losses. Second, an increase in market interest rates after the subsidy is obtained will increase the value of the subsidy more than an equal decrease will lower it because the rate increase will lengthen the period the subsidy will be earned. Thus interest rate uncertainty, too, adds value to the correctly measured subsidy measure beyond that traditionally measured. As a crude way of accounting for both the default and interest rate options, we have recalculated subsidy rates adding one-half percentage point to the market interest rate on 70 percent loans.

The value of the subsidy per square meter during the 1990-92 period is given in Table 3 for apartments constructed during the 1977-92 period under the two assumptions regarding the market interest rate used in the calculation. As can be seen, adding the one-half point markup raises the subsidy by 15 to 25 per cent on an apartment less than a decade old. During our sample period only 8 per cent of the “pure” apartments had subsidies and the average ratio of subsidy to apartment price for those with subsidies was 25 per cent. More of the mixed buildings had subsidies (15 percent), but the subsidy was only 14 per cent of value on average because commercial space is not eligible for subsidy. In all, 38 buildings had subsidies.

In the estimation, the subsidy variable is expressed as a fraction of the predicted sales price of the house, not the actual. If the actual sales price were used as the divisor in calculating  $\lambda$ , this would create an obvious endogeneity

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<sup>5</sup> BEHT (1997) discuss alternative assumptions and also compute subsidy values under the assumption of perfect foresight.

problem because the sales price would appear on both sides of the equation. We handle this by estimating a hedonic price equation not including the subsidy variable or rent among the regressors in a first step, but adding a number of age related variables. In a second step we compute our measure of  $\lambda$  based on the predicted value from this first-stage regression.

**Table 3: Present Values**

Year of production	Subsidy per Square Meter (Swedish Crowns)					
	No Markup			Markup		
	1990	1991	1992	1990	1991	1992
1977	990	443	340	1189	676	554
1978	745	251	155	935	432	308
1979	999	401	273	1201	618	480
1980	1610	899	739	1820	1199	1057
1981	2112	1210	1006	2425	1550	1385
1982	2444	1501	1278	2782	1906	1634
1983	2825	1777	1525	3189	2249	1980
1984	2982	1894	1631	3327	2378	2126
1985	3105	1925	1637	3430	2412	2160
1986	3596	2486	2154	4020	2959	2698
1987	3845	2752	2395	4314	3320	2899
1988	4304	3445	3065	4822	4100	3703
1989	4627	3791	3372	5145	4486	4095
1990	6226	5266	4657	6692	5974	5455
1991		4809	4511		5500	5308
1992			4143			4838

The density and subsidy data suggest that the capitalization rates in Table 1 could be quite misleading. Consider apartments. Included in these transactions are low rise and high rise units in a wide area of greater Stockholm. And older apartments have no subsidies, while apartments build since the late 1970s have subsidies worth a fifth of their selling price, on average. If the composition of apartments sold shifted significantly across time, changes in the cap rates will reflect that shift, as well as changing market conditions. The commercial data are even more problematic. Not only is there a wide variation in types of buildings sold (small retail, large malls, small office and high rise office), as well as location, but the number of sales is low and thus the impact of changing composition is likely to be great.

## Results

The coefficients on the key rent, subsidy, and density variables, as well as their standard errors (in parentheses) and the equation adjusted R2 and standard error are listed in Table 4. In the first column we use the subsidy measure based on the market interest rate on 70 per cent LTV loans. The coefficient on the rent variable is 0.87 with a standard error of 0.11, and the coefficient on the subsidy variable is -1.27 with a standard error of 0.20. While the rent coefficient is a bit low and the capitalization a bit high (in absolute value), neither coefficient is as much as two standard errors from the expected unity and minus unity values. The density variable for all properties has a coefficient of 0.10, over three times its standard error. The adjusted R2 is 0.66, and the equation standard error of estimate is 0.35. Given that we have gross potential (not net effective) rents and that no adjustments have been made for special circumstances, this explanatory power seems reasonable.

**Table 4: Rent, Subsidy, and General Density Effects**

Equation	no markup in subsidy	half percent markup	rent and sub constrained
Ln Rent	0.869 (0.106)	0.865 (0.106)	1.0
Ln(1- $\lambda$ )	-1.27 (0.20)	-1.01 (0.16)	-1.0
Ln Density	0.103 (0.033)	0.101 (0.033)	0.097 (0.033)
R <sup>2</sup> adj.	0.66	0.66	
Equ SEE	0.35	0.35	0.35
# obs	403	403	403

The large capitalization estimate may reflect an underestimate of the value of the subsidies. The second equation uses the subsidy measure where the market interest rate includes a 0.5 percentage point markup to account for the two difficult to measure option values. Here the rent coefficient is unchanged, but the capitalization coefficient equals the expected minus unity value with a standard error of only 0.16. We conclude from these estimates that subsidies were fully capitalized into value.

The last column in the table shows the result with the rent coefficient constrained to 1.0 (and subsidy coefficient maintained at -1.0). Note that the

density coefficient is roughly constant across these equations, and that the equation standard error in the third equation is the same as in the second. No explanatory power is lost through these constraints.

Thus we compute our constant quality capitalization rates constraining both the rent and subsidy coefficients to their expected plus and minus unity values. Table 5 reports the other relevant coefficients from this constrained estimation: the general time effects (applicable to all properties), the apartment specific time effects relative to commercial properties, and the commercial specific density effects, which are allowed to vary over time. The first row is an all-period effect (the first coefficient is the constant term); the next four rows give the effects relative to that in the first half of 1990.

The post-902 all-property time effects are, with one exception, increasingly negative and statistically significant. This suggests rising constant-quality cap rates over time (cap rates move inversely with the dependent variable). The all-period apartment specific time effect is negative and significant, suggesting higher apartment than commercial cap rates. The post-902 coefficients are generally insignificant, but that for the last period (922) is positive

**Table 5: Time Effects for Apartments and Commercial**

Date	All property	Apart. specific	Comm. density
all periods	2.668 (0.102)	-.454 (.123)	.273 (.083)
911	-.268 (.133)	.267 (.164)	-.121 (.103)
912	-.236 (.141)	.014 (.173)	-.141 (.103)
921	-.417 (.148)	.158 (.179)	-.248 (.124)
922	-.802 (.170)	.527 (.207)	-.330 (.120)

and significant, acting to lower the cap rate in 922. The commercial density coefficients shift from positive and significant in 902, suggesting a lower cap rate for commercial properties than for apartments, to negative in 992 (0.273-0.330), suggesting an erosion in the apartment-commercial cap rate gap over

time. Of course, the density time effects increase as the level of density increases (the effects are greater for high rise buildings than for low rise).

The location dummies, not reported, have coefficients ranging from -0.38 to +0.48 (five of these coefficients have t-ratios of 1.7 or greater). The impact is large, depending on the level of the cap rate in the base area. The impact roughly equals this level, ranging from 5 percentage points at a 5 per cent base cap rate to 10 percentage points at a 12 per cent base cap rate. Moreover, commercial sales were relatively strong in the high cap rate regions in 902 and 921.

Constant-quality apartment cap rates are computed for apartments with zero subsidies and, alternatively, with high (3.5) and low (0.5) densities. Cap rates for apartments with a given level of subsidy can be obtained by dividing those of unsubsidized apartments by  $1-\lambda$ , where  $\lambda$  is the ratio of the present value of the subsidy to the selling price. The commercial cap rates are for low rise retail (density of 0.5) and high rise offices (density of 3.5).

Figure 1 plots the actual mean cap rates for apartments for our five time periods, and the cap rates for constant quality low and high density unsubsidized units. We would expect the actual rate to lie between those computed for high and low density units. This is generally the case during the first two periods, but the actual cap rate is too low in 912 and 921, and then too high in 922.

Figure 2 plots the observed mean cap ratio for commercial properties and the cap rates for constant quality/location low and high density units. Here we would expect the actual rate to be slightly under the low density rate. Relative to this expectation, the actual rate is far too high in both the second half of 1990 and the first half of 1992, periods when sales occurred in high cap rate subregions.

Figure 1: Apartment Actual and Constant-Quality Cap Rates

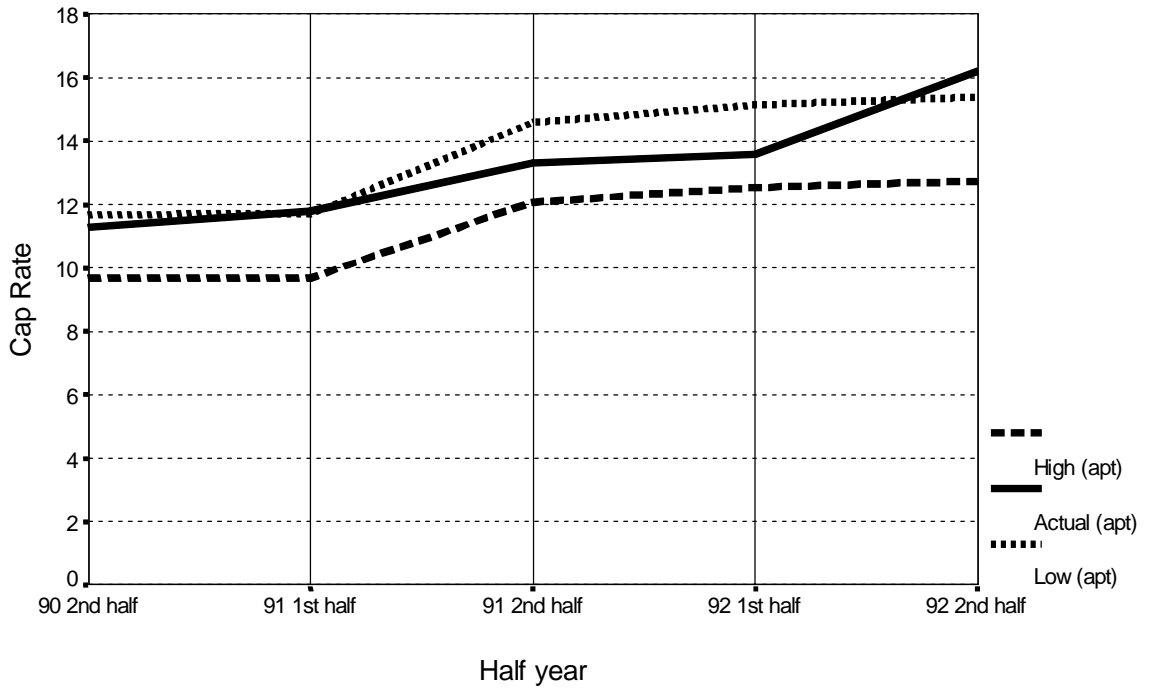
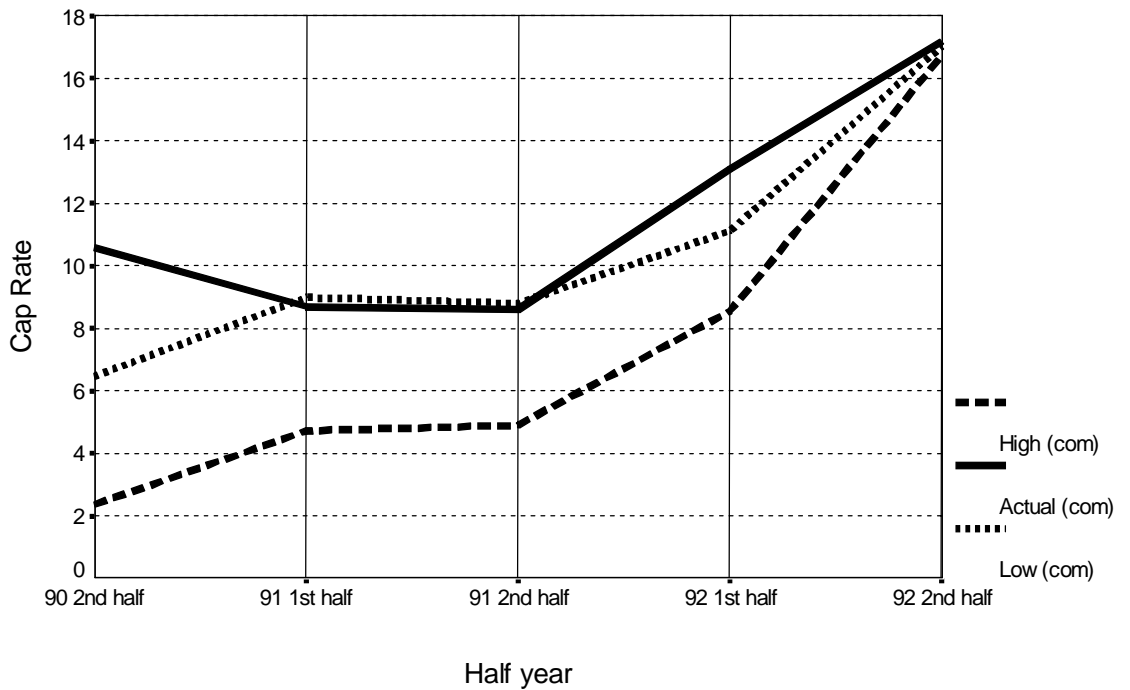


Figure 2: Commercial Actual and Constant-Quality Cap Rates



## **Conclusion**

Because movements in capitalization rates are important to understanding real estate markets, significant effort should be devoted to the calculation of accurate “constant quality” cap rates, i.e., cap rates holding property characteristics constant. These include property type, location, lease terms and, particularly for Swedish apartments, financing terms. Given the limited number of properties that actually sell in a period, simple average cap rates are likely to be far from accurate.

The cap rate formulation implies that the logarithm of price will be related to the logarithm of rent with a unity coefficient and, for Swedish apartments, the logarithm of unity less the fraction of sales value attributable to subsidies (or below-market financing) with a minus unity coefficient. The data are fully consistent with these expectations, i.e., the subsidies appear to have been fully capitalized into price.

The other results are also consistent with expectations. Property type matters. Holding other factors constant, apartment cap rates are lower than commercial cap rates, and within the commercial class office cap rates are lower than retail (the greater the number of stories in a building, the lower the cap rate). Finally, location matters. The data suggest rising cap rates over the 1990-92 span, with the increase being greatest for high-rise commercial (office) and least for apartments.

Our constant-quality cap rates move substantially different from the averages of cap rates of individual apartments and commercial properties in Stockholm. This suggests that earlier research using average cap rate data to show the absence of the integration of U.S. real estate markets with capital markets may be of limited relevance. We believe these results are promising and would like to use the methodology to produce cap rate indices based upon a richer data set.

## References

- Ambrose, B. and H. O. Nourse, "Factors Influencing Capitalization Rates," Journal of Real Estate Research, 8, 1993.
- Burger, T., P. Englund, P.H. Hendershott and B. Turner, "Another Look at the Capitalization of Interest Subsidies: Evidence from Sweden," September 1997.
- Froland, C. "What Determines Cap Rates on Real Estate," Journal of Portfolio Management, 13, 1987, 77-83.
- Gau, G.W., "Impact of Creative Financing on the Market Prices of Apartment and Commercial Properties," Property Tax Journal, 5, 1986, 203-218.
- Hendershott, P.H., "Rental Adjustment and Valuation of Real Estate in Overbuilt Markets: Evidence from the Sydney Office Market," Journal of Urban Economics, 37, 1996, .
- Jaffee, D.M., "The Swedish Real Estate Crisis," report prepared for The Center for Business and Policy Studies, SNS, Stockholm, September 1994.
- Jud, G. and D. Winkler, "The Capitalization Rate of Commercial Properties and Market Returns," Journal of Real Estate Research, 10, 1995.
- Nourse, H. O., "The 'Cap Rate,' 1966-1984: A Test of the Impact of Income Tax Changes on Income Property," Land Economics, 63, 1987, 147-52.
- Sirmans, G.S. and C.F. Sirmans, "Financing Premiums and Selling Price of Residential Income Property," Property Tax Journal, 5, 1986, 175-189.
- \_\_\_\_\_, "Rents, Selling Prices, and Financing Premiums, Urban Studies, 28, 1991, 267-76.

## Appendix A: Derivation of Cap Rates with a Differential Initial Expected Rental Growth Rate

Assuming rents will rise at rate  $a'$  for  $N$  periods and thereafter at rate  $a$ , the value of a prop

erty with initial rent  $R$  is,

$$V = \sum_{t=1}^N \frac{R(1+a')^t}{(1+r')^t} + R \left( \frac{1+a'}{1+r'} \right)^N \sum_{t=1}^{\infty} \frac{(1+a)^t}{(1+r)^t} \quad (\text{A1})$$

where  $r' = r + p$  is the discount rate. The second summation is simply,

$$\frac{R}{r' - a} \left( \frac{1+a'}{1+r'} \right)^N$$

and the first summation is

$$\frac{R}{r' - a'} - \left( \frac{1+a'}{1+r'} \right)^N \frac{R}{r' - a'}$$

Substituting in (A1),

$$V = \frac{R}{r - a'} \left[ 1 - \left( \frac{1+a'}{1+r'} \right)^N \right] + \frac{R}{r - a} \left( \frac{1+a'}{1+r} \right)^N \quad (\text{A1}')$$

Denoting  $\left[ (1+a')(1+r') \right]^N$  by  $X$  and  $\left[ (1+a)/(1+r) \right]^N$  by  $Z$ , we solve the cap rate as

$$\frac{R}{V} = \frac{r - a}{X(1 - Z) + Z}$$

## Appendix B: the Swedish Apartment Subsidy System

Residential construction in Sweden is financed through special purpose loans that are subsidized by the government. The amount of the loan is determined from a "loan basis," which usually constitutes about 99 percent of production costs. These loans are, under current legislation, split into a "bottom" loan and a "housing" loan. The bottom (or first) loan provides 70 percent of the loan basis, while the housing (or second) loan provides 25 percent.

The bottom loans are provided by various private credit institutions, and the higher risk housing loans are made by Statens Bostadsfinansieringsaktiebolag. The bottom and housing loans are fully assumable upon sale of the house. Bottom loans have a 40-50 year maturity, while the housing loans have a 30 years maturity

For bottom and housing loans, the borrower pays a government determined "guaranteed" interest rate plus one per cent each year on the initial loan amount. The government covers the gap between the guaranteed rate and the going market interest rate less the one percentage point. The scheduled pattern of guaranteed rates going forward from 1990 for different vintage apartments are shown below. The average market interest rate for 1990 was 15.3 per cent. In 1992 and 1993 it was 13 per cent.

Year	Year of production												
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1990	5.30	5.10	4.45	4.20	4.10	4.25	3.60	3.35	3.10	2.95	2.70	.	.
1991	6.25	6.05	5.40	5.15	5.05	5.20	4.55	4.30	3.65	3.50	3.25	3.40	.
1992	6.80	6.60	5.95	5.70	5.60	5.75	5.10	4.85	4.20	4.05	3.80	3.65	3.40
1993	8.88	8.33	7.53	7.13	6.88	6.73	6.03	5.78	5.08	4.83	4.53	4.33	4.03
1994	9.25	8.70	7.90	7.50	7.25	7.10	6.40	6.15	5.45	5.20	4.90	4.70	4.40
1995	9.60	9.05	8.25	7.85	7.60	7.45	6.75	6.50	5.80	5.55	5.25	5.05	4.75
1996	9.95	9.40	8.60	8.20	7.95	7.80	7.10	6.85	6.15	5.90	5.60	5.40	5.10
1997	10.30	9.75	8.95	8.55	8.30	8.15	7.45	7.20	6.50	6.25	5.95	5.75	5.45
1998	10.65	10.10	9.30	8.90	8.65	8.50	7.80	7.55	6.85	6.60	6.30	6.10	5.80
1999	11.00	10.45	9.65	9.25	9.00	8.85	8.15	7.90	7.20	6.95	6.65	6.45	6.15
2000	11.35	10.80	10.00	9.60	9.35	9.20	8.50	8.25	7.55	7.30	7.00	6.80	6.50
2001	11.70	11.15	10.35	9.95	9.70	9.55	8.85	8.60	7.90	7.65	7.35	7.15	6.85
2002	12.05	11.50	10.70	10.30	10.05	9.90	9.20	8.95	8.25	8.00	7.70	7.50	7.20