STOCKHOLM SCHOOL OF ECONOMICS
MASTER'S THESIS IN FINANCE

PROPERTY CAPITALIZATION RATES AND INVESTOR RATIONALITY IN STOCKHOLM

ABSTRACT

We have established that real rents for office contracts in the Stockholm Central Business District are mean reverting. Do investors realize that mean reversion actually exists and have they managed to incorporate this development into capitalization rates? In order to examine this question we have applied a model constructed by Hendershott and MacGregor to Swedish property data linking property capitalization rates to both future real rental growth and the stock market. We have also included a qualitative section linking the results of our model to actual events on the property market. The most prominent results of the model is the significance and importance of proxies for expected growth in real rents and dividends reflecting mean reversion in the time series. Our results are mainly in line with those of Hendershott and MacGregor and even though our empirical model is based on fairly simplistic assumptions, it gives some support to that capitalization rates in the Stockholm CBD reflect rational expectations of mean reversion in future rents.

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1. INTRODUCTION

The question of whether investors, analysts or appraisers are rational in their expectations is applicable to more than one area of investments. What irrationality is defined as of course differs between these areas, but in general it should not lead to optimal investment decisions. Of course, one can judge this first in hindsight. Foreseeing the future however, is naturally very difficult, if not impossible, and also the main problem of valuation. A common way to make projections of the future is to look back and see how prices, rates, costs or whatever it may be have developed over time and in the light of this make an estimation of the future development. Sometimes an average of the previous development is used and sometimes the level is simply determined by the appraiser him/herself. If the previous development is very volatile it of course makes matters more difficult, if however the development is either cyclical or stable over time, the future should be more predictable.

As for the real estate market, a well-documented characteristic is the mean reversion of real rents. This feature of real rental growth can be logically explained by relatively simple supply and demand theories. In essence this implies that when real rents are expected to be high and the vacancy rates low, the value of property will increase, more construction of property will take place and after a while real rents will start falling as increasing vacancy rates offset further increases in real rents. When rents are instead low, new construction and development is postponed and eventually rents will start increasing following the mirror image of the above reasoning.[1] In other words, good times cannot last - and neither can bad times. With this historically observed cyclicality in real rents, which we will later look further into, one can examine whether investors incorporate this mean reversion characteristic into their expectations of future real rental growth by studying the development of capitalization rates (cap rates)[2] on real estate over time.

[1] Hendershott 1996, p. 2
[2] Cap rates are also often referred to as property yields and defined as net operating income divided by property value

Studies regarding investor rationality in valuing property have previously been made on the Australian, U.K. and U.S. markets. The results from these studies differ somewhat in both methodology and results. The studies made on the Australian and U.S. markets show investor irrationality, as investors have failed to sufficiently raise cap rates at rental cyclical peaks in anticipation of lower rental levels. The opposite would be true for rental cyclical dips, where investors instead overestimate cap rates and analogically undervalues property. The study made on the U.K. market on the other hand shows that cap rates reflect rational expectations of mean reversion of real rents.

Also the Stockholm Central Business District (CBD) office property market has showed clear signs of cyclicality in real rents and the question in this thesis is the same as for previous studies; *Do investors realize that mean reversion actually exists and have they managed to incorporate this development into cap rates?* In this thesis we will examine the behavior and rationality of Swedish property investors primarily with respect to their expectations of real rental growth. This will be done by presenting a model for cap rates on the Stockholm CBD office property market, based on a model used by Hendershott and MacGregor (2005), and a more qualitative section based on interviews with property appraisers. The Stockholm CBD is interesting to examine as it is one of the largest office property markets in Europe.[3]

We will commence this thesis with a section on theory and previous research followed by a section where we present our method. We will then introduce the data we have used and thereafter present our regression analysis followed by a section on shortcomings. After this comes the qualitative section and then finally we present our conclusions. To produce our model and this thesis we have used various sources of which the most important are articles on similar subjects and two interviews.

[3] Invest in Sweden Agency (www.isa.se)

2. THEORY

2.1. CYCLICAL RENTS

The empirical evidence on cyclical rents (mean reverting rents) has several logical explanations. First of all, in equilibrium, real estate will approximately be valued at its replacement cost.[4] When values exceed replacement costs in the market, new construction will take place successively increasing the supply of office space. This will in turn raise vacancy rates and thus lower rent levels. Equivalently, when replacement costs exceed property values, new construction is postponed, lowering vacancy rates and raising rents. Furthermore, surging real rents on newly written lease contracts due to rising demand for space should be partially reversed when the existing tenants are faced with higher rents at the renewal of their contracts.[5] A real rental index for the Stockholm CBD between 1972 and 2002 is depicted in Figure 1 below.

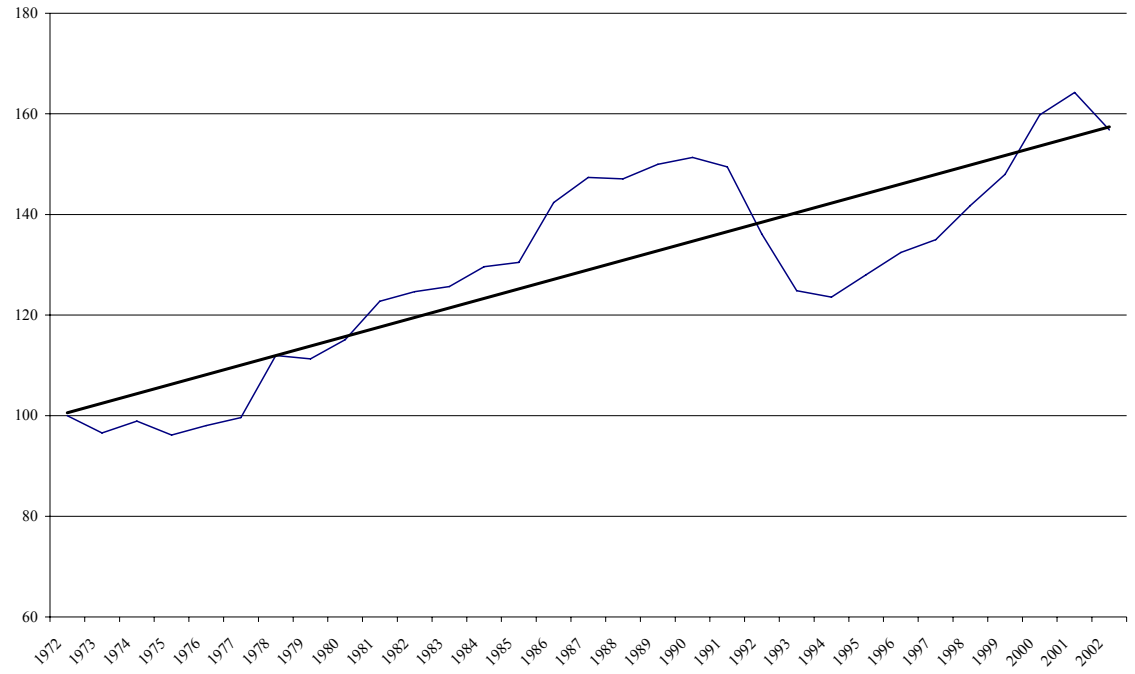


Figure 1. Real rental development in the Stockholm CBD between 1972 and 2002.

[4] Hendershott, 1996, p. 51
[5] Hendershott and MacGregor, 2005, p. 300

2.2. TEST FOR MEAN REVERSION AND SERIAL CORRELATION

In our thesis we argue that a rational investor should realize two important aspects of real rental growth; mean reversion and serial correlation. In order to substantiate our argumentation of a rational property investor, we test our rental time series data for both of these statistical occurrences. To do this, we first estimate a linear trend from our logged real rental time series data according to equation 1 below.

$$\log R_t = \beta(t - t_0) + \varepsilon_t \quad \textbf{(1)}$$

In order to test for serial correlation and mean reversion, we then run the following regression:

$$\Delta \log R_t = \beta_1 \Delta \log R_{t-1} + \beta_2 \varepsilon_{t-1} \quad \textbf{(2)}$$

The regression results are summarized in Table 1 below:

Table 1. Regression output for equation 2.

COEFFICIENTS [1]

	Unstandardized Coefficients		Standardized Coefficients			
Model	B	Std. Error	Beta	t	Sig.	*Expected sign*
(Constant)	0,023	0,025		0,945	0,353	
β_1	0,497	0,178	0,481	2,797	0,010	+
β_2	-0,214	0,091	-0,407	-2,363	0,026	-

1) Dependent Variable: $\Delta Log\ R_t$

As can be seen in the table, both of the coefficients (β_1 and β_2) are statistically significant. The distance from the trend, or equivalently the error term, has a negative sign. This is in line with expectations of a mean reverting trend since when rents are above their long run trend; the change in rents (ΔR) should be negative. Moreover, as the sign on the first order serial correlation coefficient is positive, recent growth in rents should be extrapolated forward.

In trying to determine the expected rate of growth of real market rents, it is important to realize the above characteristics of rental growth and develop some idea of how rents develop over time.[6] The mean reversion aspect of rental development should have implications on the future expected rental growth and therefore also on the cap rate. From our results above we can conclude that there is an increased likelihood that rents will turn down and mean revert to their historical mean levels when the property market has reached historically high rental levels and as rents continue to increase. The opposite is true when markets have reached historical lows. Thus, with rational expectations, forward-looking investors should anticipate lower subsequent growth in real rents as markets are on relatively high levels. This will have implications on the cap rates. A relatively high/low rental level will be expected to revert to its mean rising/lowering the cap rate.[7]

Furthermore, the development of real rents (and dividends) generally shows signs of high first-order serial correlation.[8] As can be seen above, we have also found evidence of this statistical occurrence in our rental data. In a mean reverting or cyclical setting, identical levels of high and low rents can occur prior to and after rents have passed their cyclical highs or lows. In which direction the rents will be expected to move onwards will be dependent on recent change in rents. This implies that investors have myopic expectations on future rental growth, extrapolating high recent growth into the future. The implication on the cap rate will be the following: high recent growth will increase the probability of high future growth, leading to lower cap rates.

In series of this type, these two simple rules should be reflected in the pricing of real estate by rational Swedish property investors. On the other hand, one can never exclude the possibility that naïve expectations on the market could prevail during significant periods of time. For example, investors might expect that even when the market is at historically high levels, high recent growth in rents will continue, in turn lowering the cap rate.

[6] Sivitanides et. al., 2001, p.5
[7] Hendershott and MacGregor, 2005, p. 307
[8] Ibid

2.3. PROPERTY CAPITALIZATION RATES AND THE STOCK MARKET

The above mentioned characteristics of the real rental growth have also been documented to be valid for growth in real dividends.[9] Real dividends are plotted in Figure 2 below on a logarithmic scale. Hence, the above rational expectation theory on real property rents should also be applicable for real dividend growth. This is something we assume to be true and we therefore choose to include the same growth proxies for dividends as for rental growth in our model. Theoretically, if real dividends are above their long term trend, this should therefore rationally lead to expectations that real dividends should fall thus making property relatively more attractive.[10] This in turn should lead to downward pressure on the property cap rate.

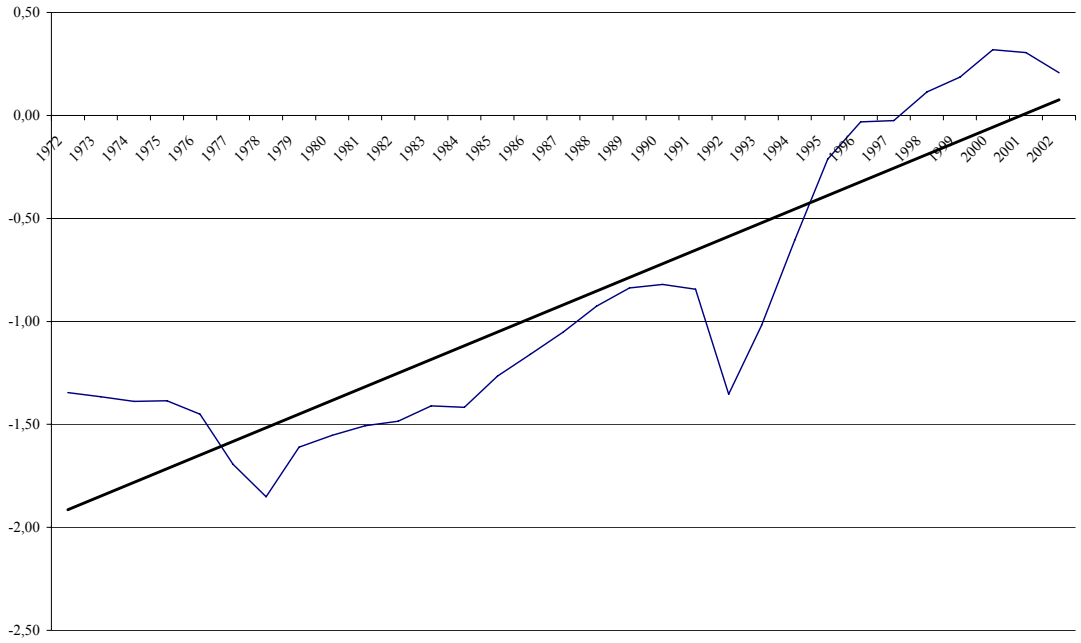


Figure 2. Real dividend development on the Stockholm All-Share Index between 1972 and 2002.

2.4. PREVIOUS RESEARCH

Various studies have been done on real estate cap rates over the years using somewhat different approaches, both statistically and considering the type of property examined. The key components believed to affect cap rates have differed and in the early literature,

[9] Hendershott and MacGregor, 2005, p. 307
[10] Hendershott and MacGregor, 2005, p. 320

links to the bond market were underscored, while links to stock cap rates were uncommon. The first literature that linked the property cap rates to stock cap rates came from US authors Evans (1990) and Ambrose and Nourse (1993). In 1995, Jud and Winkler modeled property cap rates using bond and stock market rates. As the choice of underlying variables grew more sophisticated, so did lag structures, which can be seen in Sivitanidou and Sivitanides (1999) and Sivitanides et al (2001). One of the most recent studies by Hendershott and MacGregor (2005) argue that UK office and retail property cap rates are linked to capital market cap rates because these two rates should incorporate the real default-free rate and also reflect the same risk factors. Also, they argue the property cap rates should be linked to bond rates. This is the model they presented, where K_p is the cap rate on property, K_s the cap rate for corporate stocks, w is the property beta, g_p is the expected growth in real rents, g_s is the expected growth in dividends and RR_b is the real risk-free rate.

$$K_p = wK_s + wg_s + (1-w)RR_b - g_p$$

Sivitanides et al (2001) also point out the real estate market's relationship to the securities market by using the analogy between PE (Price to Earnings) and cap rate. They examine whether the property cap rate act similarly to PE in reflecting the underlying asset's growth opportunities but do not incorporate any securities market related variable in their model. Our model over office property in the Stockholm CBD is to a large extent similar to the one used by Hendershott and MacGregor, but we also comprise vacancy rates in our calculation of the cap rate. The rational behind incorporating the vacancy rates is that we want to measure the net operating income in a more precise manner resulting in a better measure of the cap rate. Hendershott (1996) acknowledges that vacancy rates have an evident rolein the cyclicality of cap rates. Wheaton and Torto (1994) examine the relationship between rental movements and vacancy rates and as opposed to previous literature, in which the relationship is assumed to be linear, they argue one should also account for tenant mobility which will increase the statistical and theoretical significance of the model. This, however, has not been taken into consideration in this thesis.

3. METHOD

A common approach to general valuation is the discounted cash flow model. This model is also widely used within property valuation. The corner stone of property valuation is to make predictions regarding rents, operating costs and vacancies. These inputs generate expectations of future cash flow generated from property. A value of the property can then be derived by using the discounted cash flow method, i.e. through discounting these cash flows using a certain discount factor. The discount factor should reflect the risk and uncertainty in the expected cash flows. Assuming constant growth and discount factors, one arrives at the well-established Gordon formula, which is also the foundation of our model. In accordance with this setting, the price of real estate is assumed to be

$$P = \frac{CF}{R_p - g_p - \pi} \quad \textbf{(3)}$$

Here the cash flow is represented by net rents or a *net operating income* (NOI) and R_p is the required rate of return on property. The growth rate has been split up between the general inflation, π, and the expected growth in real rents, g_p. Defining the cash flow more precisely, we define it as rents (R) minus operating costs (K) adjusted for vacancies, (v):

$$CF = (1 - v) * R - K \quad \textbf{(4)}$$

The cap rate is expressed as $C_p = \frac{CF}{P}$ **(5)**. Combining equation 3 and 4 and solving for the cap rate results in the following expression:

$$C_p = R_p - g_p - \pi \quad \textbf{(6)}$$

Continuing now in a Capital Asset Pricing Model (CAPM) framework we specify the required rate of return, R_p, as the risk-free rate (RR_b) plus a property beta (β_p), multiplied by the excess return on the market (here assumed to be the required return on stocks, R_s) relative to the risk-free rate. We arrive at the following expression:

$$R_p = RR_b + \pi + \beta_p\left[(R_s - (RR_b + \pi)\right] \textbf{ (7)}$$

Assuming constant growth in real dividends and a constant required return on equity, we can express the cap rate for stocks in the same manner as in equation 4:

$$C_s = R_s - g_s - \pi \textbf{ (8)}$$

Substituting equation 8 into equation 7 and the result into equation 6, we arrive at the following expression for the real estate cap rate after the inflation terms have been canceled:

$$C_p = \beta_p * C_s + \beta_p * g_s + (1 - \beta_p) * RR_b - g_p \textbf{ (9)}$$

This expression indeed contains somewhat simplified assumptions. For instance, it is rather unlikely that growth rates and future discount rates are expected to be constant at each point in time. Moreover, a true market portfolio obviously contains more than stocks. Anyhow, equation 9 is a structured model that specifies and motivates our empirical estimation in this paper. We thus expect to find the following relationship between our dependent variable and the explanatory variables:

$$C_p = C_p(\overset{+}{C_s}, \overset{+}{g_s}, \overset{+}{RR_b}, \overset{-}{g_p}, \overset{+}{\beta}) \textbf{ (10)}$$

The sign above each variable indicates the sign of the partial derivative with respect to the dependent variable. As can be seen, only the cap rate for stocks (dividend/price ratio)

can be observed which is why we need to develop proxies for the rest of the variables. Furthermore, we also note that C and g theoretically are perfectly negatively related to each other and they can therefore not both be included in the regression. However, as already mentioned, g cannot be observed, which is why we will include, as regressor for g, two proxy determinants specified in the data section below.

4. DATA

As just mentioned, the cap rate is defined as the cash flow, or net operating income, from real estate (defined as rents – operating costs) divided by price level. To model property cap rates is generally difficult much due to the slow adjustment of underlying variables.[11] This slow adjustment generally depends on the fact that price indices are often appraisal based, resulting in that they do not reflect the actual price level in a satisfactory manner. Moreover, rental contracts are signed over several years, which means that the average rental level does not reflect newly signed rental contracts. For example, changes in variables such as interest rates do not have an effect on the cap rate until a new contract, after an undefined time period, is formed. However, we are using price and rental indices that are transaction based which in turn means that our cap rate reflects the actual current level and is thus not affected by any slow adjustment of underlying variables. This will be discussed in detail in the below sections covering rent and price indices.

In this section we will also describe the different variables we use in our model and give intuitive explanations for their respective participation. All variables in our model are based on annual data over the period 1972-2002. Ideally, the rental and price indices would have been based on for example quarterly data to achieve a more extensive series. However, this was not possible as the data availability of new rental contracts was simply too low on the Stockholm CBD.

4.1. RENT INDEX AND OPERATING COSTS

Our rental index is based on new office rental contracts formed each year on the Stockholm CBD. Logically, the number of new contracts varies over time but those formed still give a clear indication of the current rent level. More precisely, since the index is based on newly signed contracts, the index does not reflect the average rent level since it takes time before old contracts are renewed. However, since our price index is also based on recent transactions as will be discussed in the following section, our

[11] Hendershott and MacGregor, 2005, p. 307

measure of the cap rate is consistent. The rent index we are using in our model for the years 1972-1991 comes from Gunnelin and Söderberg (2003), who conducted a study of Term Structures in the Office Rental Market in Stockholm. They collected their data from two major property owners in the Stockholm CBD. Englund, Gunnelin, Hoesli and Söderberg (2004) conducted a study of Implicit Forward rents as Predictors of Future Rents over the years 1998-2002 using data from Svenskt Fastighetsindex (SFI). Englund et al also continued to build on the index compiled by Gunnelin and Söderberg to fill in the gap between 1991 and 1997 and create a complete index for 1972-2002, and we have used their data for these years.

To arrive at the net operating income from real estate the rents have to be adjusted by operating costs. The operating costs in our model are based on data from SFI and unfortunately they are only available back to 1997. No other source than this was available to us and we therefore had to estimate the cost index backwards in time until 1972. Since a substantial part (on average around 60%) of the operational costs is related to the costs of employees, like for example Property Care, Maintenance and Administration, and the rest of the costs are scattered across various areas, we chose a wage index from SCB (Statistics Sweden) to extrapolate them backwards which in our view was a reasonable approach.

4.2. REAL ESTATE PRICE INDICES

To find an appropriate price level variable one can either use an appraisal based approach or a transaction based approach. The first is based on analysts' assumptions while the latter is based on actual transactions. A transaction based approach is preferable since it in a better way reflects the actual current price level. The formation of a transaction based index is conditioned upon the existence of a sufficient number of underlying transactions actually made during a certain period. Also, the transactions made must be similar with respect to quality and location of the property to produce a valid index. We have used a transaction based index which we received by Bo Söderberg of the Royal Institute of Technology in Stockholm and the original source for the index is, for the years 1972-1992, the Swedish Land Registry through SCB. For the years 1992-2002 the source is the

consulting firm Svensk Fastighetsindikator (Swedish Property Indicator), which has provided a commercial version of the same index. The dataset underlying this index was originally collected for the tax assessment of property and contains various attributes regarding the use and location of property, of which those applicable on the Stockholm CBD has been selected. To assemble the index a hedonic approach has been applied, i.e. a regression based model decomposing the market value of property in to different attributes such as location, size and age. See also Berg (2004) for further information on the price index used.

4.3. VACANCY RATES (V)

An increase in vacancy rates has a negative effect on cash flows from real estate and thus also on the cap rate. As mentioned earlier, through simple supply and demand arguments, rents will not generally increase or decrease before the vacancy rate is altered. In order to calculate the cap rate as accurately as possible we therefore believe vacancy rates should be adjusted for. Thus we have, as opposed to previous studies by Hendershott and MacGregor (2005), Sivitanides et al (2001) and Hendershott (1996), chosen to adjust cash flows for vacancy rates when calculating our cap rate. The vacancy rates we use were compiled by Riksbanken (the Swedish Central Bank) using data from Newsec.

4.4. PROXIES FOR RENTAL AND DIVIDEND GROWTH (g_P, g_S)

As mentioned in the method section, the growth variable (g) for both property rents (p) and stock dividends (s) is, ceteris paribus, negatively related to the respective cap rate. Moreover, the expected growth rate is unobserved which is why we instead include two proxy variables that capture the components of the expected rental and dividend growth that we have chosen to study. The proxies for expected future growth in real cash flow (rents and dividends) should mirror both the serial correlation and the mean reversion. In order to capture mean reversion we include, as also done by Hendershott and MacGregor (2005), a variable that measures the deviation of the current rental level from an estimated linear trend. In order to capture a relative measure we have used logged values when estimating the linear trend and deviation. The intuition behind the mean reversion proxy is illustrated in Figure 3 below. We name these mean reversion proxy variables

rentdist and *divdist*. The serial correlation is captured by including one year lagged values of the growth rate (percentage changes) in real rents and dividends. Recent levels of growth rate in real rents and dividends are assumed to be extrapolated forward. This aspect of real rental growth expectations can characterize a property investor having "myopic" expectations on future growth in rents. We name these variables *rentgrowth* and *divgrowth*.

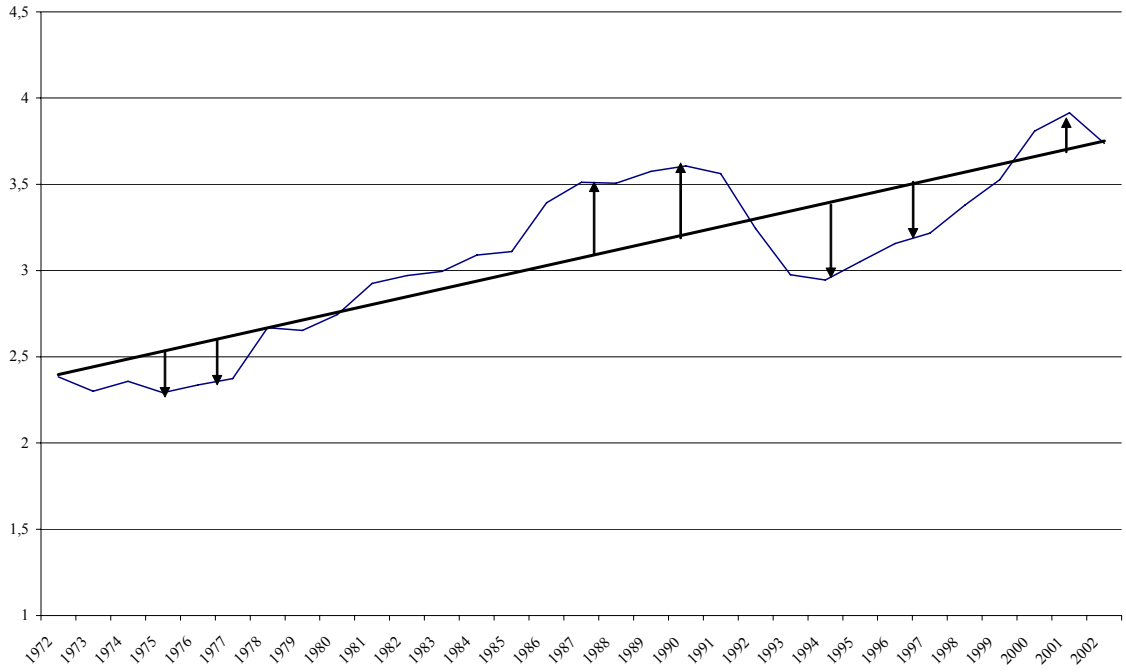
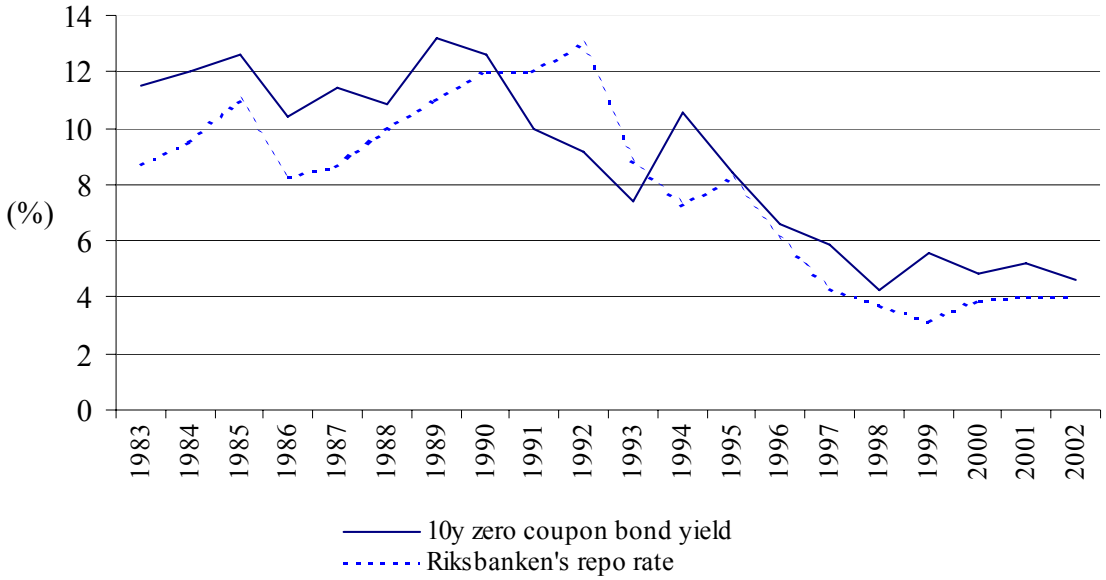


Figure 3. The mean reversion proxy captures the distance from long run trend in real rents (and dividends).

4.5. REAL RISK FREE RATE (RRb)

To find a proxy for the risk-free Swedish interest rate, the variable RR_b in our model, we used a Swedish 10-year zero coupon government bond yield provided by Datastream. However, this yield is available only back to 1983 which is also the case for any other longer term (+1 year) Swedish government bond yield. The 10-year bond is appropriate to use since it reflects the long term investment horizon that real estate investors

generally have.[12] The only Swedish interest rate we had access to back to 1972 was the repo rate, i.e. the Riksbanken tool for influencing inflation. Thence we decided to extrapolate the spread between the repo rate and the 10-year government bond yield backwards. We used the spread over the 5-year period 1983-1987 as our measure, and during these years the 10-year bond yield was on average 2,37% higher than the repo rate. The reason we did not take the average difference over the period 1983-2002 was that the Swedish financial market during this period underwent substantial regulatory changes, and the first five year period is thus more representative than the entire period. Please see Figure 4 below for the relationship between the two interest rates. The 10-year yield we use in our model is adjusted for inflation using one-year changes in Swedish CPI. We therefore assume that the current inflation is a valid approximation for the expected inflation.



Source: Riksbanken and Datastream

Figure 4. 10-year zero coupon government bond and the repo rate for 1983-2002.

[12] However, as the property market becomes more speculative, some investors tend to have shorter investment horizons according to Gunnar Widsell (Newsec)

4.6. PROPERTY BETA (β_p)

To find our required rate of return, we will apply the CAPM framework of Sharpe (1964) and Lintner (1965). The CAPM has been criticized for having empirical failings which limits its applicability.[13] It is however theoretically sane while also being simple, which is why we, as well as Hendershott and MacGregor did in their model, find it applicable in this thesis. To arrive at our required rate of return on property through CAPM the property beta (β_p) is needed. The expected or required return on property will rise with beta, which in turn rises with increased covariance in property and stock returns.[14] Since our study involves the cap rate on real estate in the Stockholm CBD it would be ideal to use a risk measure for these properties specifically. However, such a measure has not been available and therefore we have chosen to use a beta for real estate stocks on the Stockholm Stock Exchange (SSE). This measure is representative for the risk of the portfolio of all traded real estate companies in Sweden and this risk is not necessarily the same as the risk for the Stockholm CBD, but it is the best measure available.

We have arrived at the property beta by dividing the covariance of real estate stock on the Stockholm Stock Exchange (SSE) and the A-list of the SSE. The real estate data from 1972-1998 comes from Graflund (2000). From 1998-2002 the data is from Carnegie Real Estate Index (CREX). The data over the index is, for the years 1972-1973, based on all stocks listed on the A-list of the SSE, and the for the years 1974-2002 the index is based on the mostly traded stocks on the A-list of the SSE. This data was collected from Svenska Dagbladet and compiled by Söder and Trolle (2003).

There are many ways to estimate a beta and we have chosen to report an historical 5-year moving average beta in order to capture a relevant measure of the current risk premium.

4.7. STOCK CAP RATE (C_S)

The cap rate on stocks, or in other words the dividend yield, is another variable in our model. The intuition behind using this measure as a variable in the model is that there is

[13] Fama and French, 2003, p. 28
[14] Hendershott and MacGregor, 2005, p. 309

believed to be a link between the property cap rates and the capital market cap rates.[15] Both rates should reflect the real default-free rate as well as common risk factors. Also, both assets have similar, mostly private, owners and the valuation should thus in similar ways reflect risk factors and future growth expectations.[16] The source for our dividend yield is the data collected by Söder and Trolle (2003), and the yield reflects all shares on the A-list of the SSE.

[15] Hendershott and MacGregor, 2005, p. 299
[16] Sivitanides et al, 2001, p. 27

5. EMPIRICAL REGRESSION ANALYSIS

Based on the theoretical framework presented in the method section we below specify our regression model over the period 1972-2002, based on equation 10:

$$C_p = \alpha_0 + \alpha_1 C_{S_t} + \alpha_2 \mathrm{Re}\,ntdist_t + \alpha_3 \mathrm{Re}\,ntgrowth_{t-1} + \alpha_4 Divdist_t + \alpha_5 Divgrowth_{t-1} + \alpha_6 \beta_t + \alpha_7 RR_{bt} \quad \textbf{(11)}$$

We include the dividend yield (dividend/price ratio), the real rent and real dividend deviation from trend and the rate of change variables for both real rents and real dividends. The 10-year inflation adjusted government bond yield and the appraised property beta is also included. The regression results are specified in the tables below:

Table 2. Summary statistics from equation 11.

MODEL SUMMARY (1)

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
0,927 (2)	0,86	0,816	0,01321682	0,708

1) Dependent Variable: Caprate
2) Predictors: (Constant), beta5, divyield, divdist, rentgrowth, divgrowth, rentdist, GOV10YR

Table 3. Regression output from equation 11.

COEFFICIENTS [1]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	*Expected sign*
	B	Std. Error	Beta			
(Constant)	0,071	0,014		5,226	0,000	
rentdist	0,079	0,012	0,672	6,850	0,000	+
divdist	-0,250	0,010	-0,240	-2,610	0,016	-
divyield (C_s)	-0,534	0,297	-0,212	-1,799	0,086	+
GOV10YR (RR_b)	0,162	0,143	0,154	1,133	0,269	+
rentgrowth	0,050	0,020	0,234	2,548	0,018	-
divgrowth	0,017	0,017	0,102	1,024	0,317	+
beta5 (β_p)	5,93E -005	0,001	0,007	0,071	0,944	+

1) Dependent Variable: Caprate

As can be seen above and in contrast to the study performed by Hendershott and MacGregor, not all variables are statistically significant. However, on a 5 % level, both of the real rental growth proxies, in addition to the dividend mean reversion proxy, turn out to be statistically significant. The adjusted R^2 is 82%. The Durbin Watson statistic is 0,71 to be compared with Hendershott and MacGregor's 0,34. This indicates that we, as well as Hendershott and MacGregor, could have some positive autocorrelation in the error term.

The log deviation of the real rents (*rentdist*) has a positive sign. This is in line with what we would expect to find with regard to rational expectations on real rental growth. This is also in line with what Hendershott and MacGregor found both on the UK retail and office property market. If real rents currently are above their long run mean reversion trend, cap rates will increase in anticipation of rents falling, returning to their long run mean. It thus appears that investors during times characterized by historically high rental levels, rationally expects rental growth to drop which in turn is reflected in a higher cap rate. The opposite will be true during times when real rents have been historically low. The second real rental growth proxy (*rentgrowth*) is also significant but turns out to have the opposite sign relative to what we expected to find. The positive sign on the variable indicates that high (low) recent growth, in our model represented by the growth in real rents during the preceding year, will not be expected to continue during a substantial period of time,

which in turn increases (decreases) the cap rate. Our model thus does not support the theory of real estate investors having myopic expectations on the growth in real rents. Hendershott and MacGregor found this variable to be negative, indicating that UK property investors do in fact expect recent growth to have a large influence on future growth.

As opposed to Hendershott and MacGregor, our model does not find convincing evidence that the property market is priced off the stock market. However, our model does indicate, through the significance of the dividend mean reversion proxy, that dividend growth to some extent affects the property cap rate. The dividend mean reversion proxy is significant and has the expected sign, which implies that anticipation of lower growth in real dividends will make real estate a relatively more attractive investment, in turn lowering the property cap rate. Hendershott and MacGregor find all three of the stock market variables to be statistically significant, giving some evidence of that the UK property market at least partly being linked to the stock market.

The coefficient on the inflation adjusted 10-year government bond yield is not statistically significant. The fact that our model does not support a strong relationship between our real interest rate proxy and the cap rate is somewhat surprising. Both historically and theoretically one could argue that property should be priced off a base case risk-free interest rate. Assuming that property values develop inline with inflation, property cap rates should reflect the real return that a property investor demands. This return should therefore be explained by a risk-free real interest rate in addition to a risk premium. Hendershott and MacGregor do not find this variable to be significant either. Accordingly, they chose to report results of a model that assumes the real rate to be constant throughout the entire period. We however chose to report the full model including all variables since we believe the real rate to a large extent should explain the property cap rate.

In our model, the risk premium is captured by an estimated property beta. The coefficient on this variable is insignificant. Our estimation of beta is however a "best possible"

attempt which still is not very satisfactory. The reason for this is that it is based on the covariance between a portfolio of listed property companies and the SSE A-list. This beta therefore, to a certain extent, reflects a general risk premium on the Swedish property market whereas our rental and price data only focuses on CBD Stockholm. Moreover, real estate shares are much more volatile than the real estate prices themselves why the quality and relevancy of this measure of the risk premium should be questioned. We have however still chosen to include this variable in the model as we believe it should capture at least some of the risk premium associated with investing in real estate. Instead of applying a beta measure by using the regression based approach that we have used, Hendershott and MacGregor chose to use a different method. As a proxy for beta, they use data over the real estate weight in institutional investors' portfolios. They argue that a decline in the property weight probably reflects an increase in the risk premium demanded on property by institutional investors due to either an increase in the covariance between property and stocks or a decrease in the variance of stocks. In both of these cases, property value would fall and cap rates would be higher. The outcome is that they assume that the property beta is a negative linear function of portfolio property weight of institutional investors. This variable is significant in their model.

6. SHORTCOMINGS

We believe our model provides some guidance about whether investors on the Stockholm CBD property market have acted rationally or not, primarily with respect to their expectations of future growth in rents. But, our statistical model is rather weak and the applicability and significance of it is thus doubtful. The fact that we only have 30 data points decreases the statistical robustness of our empirical study. Also, the development of the Swedish property market was very turbulent in the late 80s and early 90s which we will look further into in the next section. Moreover, there are other issues in our model we would specifically like to address. First of all, the data over prices and rents we are using in our model is not based on entirely the same sources over the time period 1972-2002. This is mostly due to the fact that the companies operating in the Stockholm CBD differ over time but also that the companies that choose to contribute to the indices available to us change over time. In other words, not 100% of all companies operating in the area contribute and the index is thus not complete, but it is the best available to us. A second source of uncertainty worth bringing up is how we have arrived at the operating costs. These costs have been collected by SFI back to 1997, but to arrive at the costs before that we have made our own estimations. Since a substantial part (on average around 60%) of the operating costs is related to the costs of employees, we used a Swedish wage index to extrapolate the cost index backwards. Of course the cost index we arrived at is not ideal, but it does provide us with a satisfactory estimation. Thirdly, the interest rate we are using, the 10Y Swedish Government Bond Yield, is available only back to 1980. To estimate the years 1972-1980 we used the development of the Swedish Riksbank's repo rate, and applied this to the bond yield. This approximation was the best possible to us and in our view also a reasonable one.

Obviously, our model would have been of more interest should the years 2003-2005 also have been included, however, limited data accessibility has restricted us to the time period 1972-2002. Despite these concerns, we believe the qualitative section that follows contributes to making our thesis as a whole an interesting underlying material for further discussion on the topic.

7. QUALITATIVE ANALYSIS

7.1. HAVE INVESTORS LEARNT THEIR LESSON?

In order to obtain a more dynamic and qualitative view of the development on the real estate market and to compare the results of our model with actual occurrences on the market we decided to conduct an interview with Gunnar Widsell, a well renowned Swedish property appraiser with over 20 years of experience who is currently working with Newsec.[17] We have also met with Christina Gustafsson, Managing Director at IPD Norden. An additional approach to analyzing actual events with our regression model is to study the residuals from our regression analysis. The unstandardized residuals from equation 11 are presented in Figure 5 below. The below figure indicates some positive auto correlation in the residuals which is also supported by the low Durbin Watson statistic.

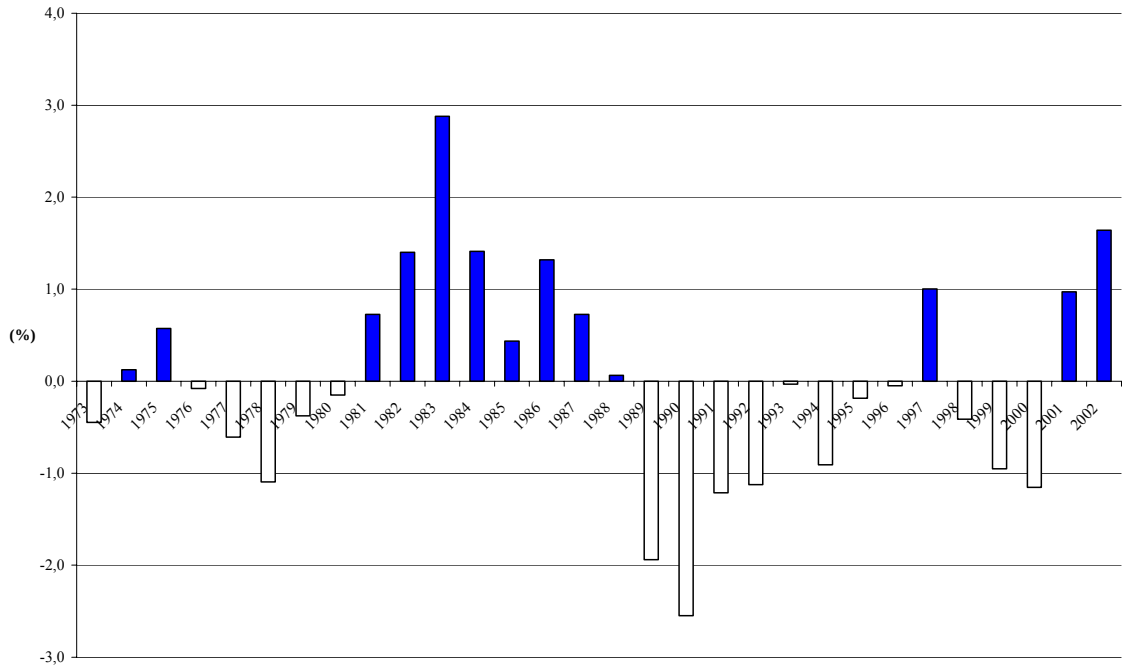


Figure 5. Unstandardized residuals from regression model (equation 11).

[17] Newsec offers consulting services to property investors, property owners and occupiers of premises in the Nordic and Baltic region.

During the last 20 to 30 years, the market has gone through periods that can be characterized as being well functioning and rational as well as periods described closer to being dysfunctional and irrational, according to Widsell. A very attention-grabbing period on the Swedish property market took place at the end of the 1980s and beginning of the 1990s. During this period, the market was, according to Widsell, in a position where property investors had expectations on high future rental growth. Cap rates on property were relatively low, even well below the prevailing borrowing rate. In opposite to how, in our definition, rational investors should react when market rents start to increase, the property investors this time failed to realize that cap rates also needed to increase in the anticipation of rents not being able to rise indefinitely. Instead, as rents kept increasing in the beginning of the 90s, the cap rate kept falling as depicted in Figure 6. The downward pressure on the cap rate was supported by expectations of high inflation and surging real estate prices. Both rising rents and the decreasing cap rates contribute to increases in property values. Investors' inability to raise cap rates during the prevailing period is also reflected in the relatively large negative residuals from our regression model, depicted in Figure 5 above. In other words, our model predicted larger cap rates compared to those actually prevailing on the market. According to our model, the cap rate should in 1990 have been approximately 2.5 percentage points higher than the actual prevailing cap rate of 6.7 percent. This double effect, rising rents and lower cap rates, led to a situation where property in general was overvalued and the crash of 1992 in retrospect seems inevitable. In light of our model, this indicates irrationality on behalf of property investors as large market forces set rational and sound economic behavior aside.

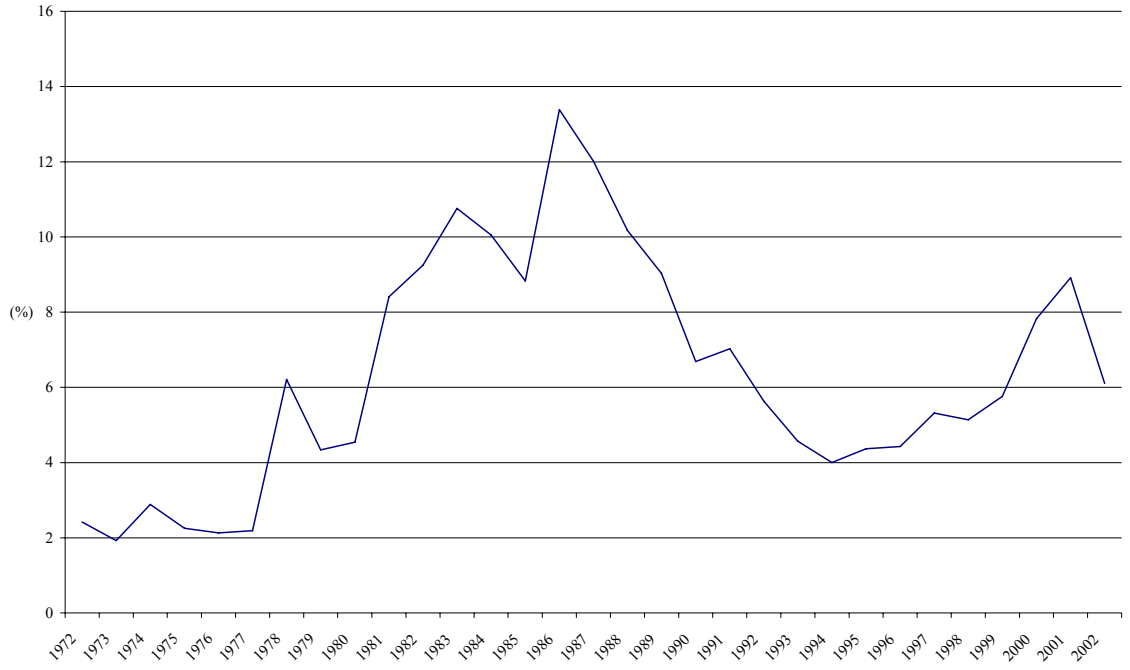


Figure 6. Stockholm CBD capitalization rates 1972-2002

Widsell believes that property investors seem to have, with the crisis of 1992 in mind, learnt a lesson. In the latter part of the 1990s, the same situation arose again with regard to expectations on rising rents. However, as rents began to increase, investors this time reacted by also raising cap rates, which is in line with our definition of rationality. This is illustrated in Figure 6 above. This reaction managed to counteract the mounting rents and property values thus did not develop in the same explosive manner as they did at the end of the 1980s. Also during this period in time our model would have predicted somewhat larger cap rates, but the residuals this time are smaller than during the crisis in the early 90s. In this case property investors can be regarded as having acted rationally both according to Widsell and in light of our model.

Today, the property market yet again finds itself in a situation similar to that in the end of both the 1980s and the 1990s. Today's property market can according to Widsell be characterized by recent downward pressure on the cap rate in the anticipation of decreasing vacancy rates and a rise in rental levels. However, Widsell stresses that a significant difference between today's situation and earlier historical periods is that the

interest rate today also is at historically low levels. Therefore, up until now, sound economic reasoning is still intact as opposed to before the crisis of 1992 where interest rates were well above cap rates even after taking inflation into consideration. Anyhow, we believe the question whether the market participants' behavior this time can be regarded as rational can be answered first in hindsight. In order to avoid another real estate bubble, as was the case during the crisis of 1992, investors this time also have to realize the necessity to counteract a future rise in rents by also raising cap rates.

At the year end of 2004, the market sentiment was that the bottom of the current downturn in rents was reached and that rents would begin to rise again during 2005.[18] This has however not been the case and rents have on the contrary fallen somewhat as vacancy rates slightly have increased. The downward pressure on office cap rates has also continued. The awaited upturn in the rental levels has in other words not yet occurred.

7.2. OTHER SOURCES OF IRRATIONALITY

In this thesis, we say that investors are rational if they manage to raise cap rates sufficiently at rental cyclical peaks in order to not overvalue property, and vice versa. But there are other aspects involved as well in the potential overvaluation of property. For example, it turns out that property analysts, for the Stockholm CBD estimate the operating costs of 2005 to be 57% of the actual operating costs of 2004.[19] Even though costs might be different in 2005 than in 2004, the high growth of recent years (on average 10% each year since 1998) indicates otherwise. According to Christina Gustafsson at IPD Norden, the underestimation of costs is a common phenomenon which is due to many investors' belief that they will be able to run property more efficiently than previous owners or during previous years. Whether the estimation of operating costs is generally in the region of 57% is unclear but to us this number seems large. The probable underestimation of operating costs leads to a general overestimation of cap rates. There are also indications that property analysts underestimate the vacancy rates. In the Stockholm CBD the average vacancy rate from 1997-2004 has been 8,4% but analysts

[18] Gunnar Widsell, Newsec AB, November 16, 2005
[19] Värderingar i SFI / IPD Svenskt Fastighetsindex 2004. Värderingsgruppens kvalitetsgranskning, p. 22

estimate the long term vacancy rate to on average 3,7%.[20] We can of course not know whether this assumption of the long term vacancy rate is correct or not, but compared to the level of 2004, 14%, and the average during the previous 8 years, it seems optimistic. The overestimating of cap rates as well as the optimistic views on vacancy rates could probably distort the return investors expect from property, and thus also the amount they are willing to pay for property. In other words, analysts' estimations could lead to investment decisions of less rational character. Investors themselves would probably argue against accusations of paying too much and motivating their decisions with a conviction that they can run the property cheaper than the previous owners. Whether they will be able to or not and whether they are rational or not, is at this point subject to speculation and factual conclusions can be drawn first in retrospect.

[20] Värderingar i SFI / IPD Svenskt Fastighetsindex 2004. Värderingsgruppens kvalitetsgranskning, p. 10

8. CONCLUSION

We have established that real rents are mean reverting. Do investors realize that mean reversion actually exists and have they managed to incorporate this development into cap rates? In order to examine this question we have applied a model constructed by Hendershott and MacGregor to Swedish property data linking property cap rates to both future real rental growth and the stock market. The most prominent results of the model is the significance and importance of proxies for expected growth in real rents and dividends reflecting mean reversion in the time series. Our results are mainly in line with that of Hendershott and MacGregor and even though our empirical model is based on fairly simplistic assumptions, it gives some support of cap rates reflecting rational expectations of mean reversion in future rents.

Furthermore, our model gives some support of the theory that real estate at least partly is priced off the equity market. The dividend mean reversion variable is significant with the expected sign, indicating that when real dividends are at a cyclical peak and thus rationally expected to fall, this will put downward pressure on the property cap rates as property will become a relatively more attractive investment. However, the current dividend-to-price ratio and the extrapolative dividend growth proxy do not significantly explain the property cap rate.

A possible explanation to the relatively weak statistical results from the cap rate model is the development of the Swedish property market during the late eighties and early nineties. This period in time can retrospectively not be said to be representative with respect to rationality on behalf of property investors. Real estate prices reached abnormal levels and a property bubble was without doubt created. This also shows up in our model as we obtain large negative residuals during this period indicating that cap rates should have been higher. Thus, we believe this period has infected the data and hampered the possibility to find strong results and the ability to draw reliable conclusions from the model.

When studying the Swedish property market more qualitatively, it becomes clear that the market has not acted the same in different rental cyclical upturns when it comes to raising cap rates in order to offset increasing rental levels. In the late 80s and early 90s, investors failed to raise cap rates sufficiently as rents went up. On the contrary, investors learned their lesson and in the next rental cyclical upturn in late 90s, cap rates were raised hand in hand with increasing rents which in turn offset surging property values.

Today's cap rates have been under downward pressure during recent years. A potential property bubble could once again form should investors not realize the necessity to raise cap rates sufficiently once rental levels start increasing. Should this not be the case, we could once again find ourselves in a similar scenario as we did before the crisis in the beginning of the 90s.

We also see indications of property appraisers underestimating operational costs and vacancy rates in their valuation. This could have an "irrational" effect on valuation and cap rates. One explanation to this behavior could be investors' belief that one could actually run property more efficiently, at a lower vacancy, than previous owners – and this could in turn motivate acquisitions of property at higher prices.

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10. APPENDIX

	CPI Sweden	Real rents, Sthlm CBD	Real prices, Sthlm CBD	Vacancy rate (%)	Capitalization rate Sthm CBD (%)[1]	SSE All share Idx	SSE Real estate shares	Dividend yield SSE All share (%)	10 Y Swedish Govt bond (%)[2]
1972	100,00	100,00	100,00	2,30	2,42	100,00	100,00	3,51	*7,37*
1973	106,68	92,09	89,33	2,80	1,92	88,78	117,87	4,13	*7,87*
1974	117,27	97,44	71,33	2,30	2,88	85,93	119,18	4,59	*8,87*
1975	128,74	91,23	55,33	1,75	2,26	105,40	209,55	4,12	*8,37*
1976	142,09	95,42	72,37	1,80	2,13	101,90	244,07	4,41	*8,37*
1977	158,20	99,11	77,94	1,85	2,19	90,74	250,00	4,32	*10,12*
1978	174,17	133,04	75,79	1,95	6,21	96,15	329,89	3,84	*9,37*
1979	186,65	130,86	104,06	2,80	4,34	85,13	428,43	5,90	*10,37*
1980	212,05	143,40	123,86	3,30	4,55	102,93	557,86	5,87	*12,37*
1981	237,74	171,95	95,87	4,00	8,41	165,54	786,83	4,29	*13,87*
1982	258,06	179,95	96,51	2,90	9,25	241,62	855,86	3,26	*12,37*
1983	281,13	184,44	86,64	3,40	10,76	378,47	1414,95	2,44	11,50
1984	303,63	202,57	107,99	2,45	10,05	335,94	1566,64	2,95	12,04
1985	325,98	206,83	126,78	2,40	8,83	439,59	1404,78	2,82	12,59
1986	339,77	274,53	123,35	1,95	13,38	623,24	2124,04	2,30	10,42
1987	354,14	309,07	156,76	3,50	12,01	540,84	2431,28	3,08	11,47
1988	374,75	307,29	181,84	4,40	10,17	823,98	3590,91	2,43	10,87
1989	398,84	329,08	223,38	3,50	9,03	1064,05	4560,86	2,19	13,21
1990	440,64	339,90	302,18	7,00	6,69	756,87	3121,26	3,45	12,58
1991	481,71	324,96	266,06	10,00	7,03	907,63	2445,53	3,08	9,94
1992	492,74	236,50	200,22	17,00	5,63	1012,97	2299,85	1,69	9,14
1993	515,67	180,75	155,14	22,00	4,57	1749,87	2727,81	1,43	7,40
1994	527,00	175,38	178,70	16,00	4,00	1821,22	3112,94	2,13	10,58
1995	540,35	195,03	196,91	14,00	4,37	2216,63	3000,54	2,66	8,41
1996	542,82	216,66	233,77	9,00	4,43	3046,43	3980,89	2,33	6,59
1997	544,85	230,20	214,18	7,00	5,32	3808,66	4267,95	1,88	5,85
1998	545,72	270,52	302,10	2,00	5,14	4049,42	4321,11	2,04	4,26
1999	547,46	313,56	312,43	2,00	5,76	6808,91	5129,24	1,31	5,56
2000	552,83	415,63	325,90	1,00	7,82	6335,43	6918,58	1,62	4,82
2001	566,33	462,47	302,53	4,00	8,92	5178,10	6516,21	2,00	5,17
2002	578,52	387,26	322,85	7,50	6,10	3125,63	6793,27	3,07	4,63

1) The capitalization rate is defined as [(1-vacancy rate)*(real rents-real operating costs)]/real prices

2) The 10 Y Swedish government bond yield has been extrapolated backwards from the year 1982-1972 using the average spread between the 10 Y bond yield and Riksbanken's repo rate over the years 1983-1988