

Strategic Risk Analysis for Real Estate Investors

Bert Kramer
ORTEC Consultants bv
P.O. Box 4074
NL-3006 AB Rotterdam
The Netherlands
Phone +31 10 498 6640
Fax +31 10 498 6667
E-mail bkramer@ortec.nl

Paper to be presented at the 8th European Real Estate Society Conference
ERES Alicante, June 2001

Strategic Risk Analysis for Real Estate Investors

ABSTRACT

By performing strategic risk analysis studies, investors can obtain insight into the risk – return characteristics of the current asset portfolio and into the most important risk drivers. Furthermore, via strategic risk analyses, investors can obtain insight into the relative effectiveness and efficiency of the policy instruments available to them. Policy instruments available to real estate investors are, for instance, sector (residential, retail, office) / market segment allocation and the term for new rental contracts. The selection of individual investments is not a policy instrument at the strategic level.

In the Netherlands, scenario analysis by means of Monte Carlo simulation is widely accepted by institutional investors to be the most appropriate way to perform strategic risk analyses. In this paper we describe the standard methodology used by these institutional investors. Up till now this methodology has hardly been applied to strategic risk analyses for (commercial) real estate portfolios. Apart from unfamiliarity with the methodology, one other reason for this is the lack of reliable historical data with respect to direct (rental income / market rents) and indirect (capital growth) returns on commercial real estate. In this paper we discuss some potential solutions to this problem. Finally, we show some preliminary results of a strategic risk analysis performed for a Dutch property investment company.

INTRODUCTION

Nowadays, institutional investors are quite familiar with quantitative methods for strategic risk analysis or Asset Liability Management (ALM) studies. In the Netherlands, virtually all large pension funds use ALM models to determine efficient¹ or ‘optimal’ asset mixes. With an ALM study, risk and return are not measured on the asset portfolio only, but on the entire fund including the liabilities. For over 80% of Dutch pension fund capital (over 450 billion Euro) the strategic asset mix is determined by an ALM study. Since the Dutch pension funds have started using ALM models in the 1980s and early 1990s, the asset mix has shifted from an average of 10% equities / 90% fixed income securities and real estate to a mix with 40% or even 60% equities. As a consequence of this shift, pension premiums could be reduced and the pensions could be improved. In the last few years, Dutch housing associations have also started using ALM models. Commercial real estate investors, however, are hardly using ALM of strategic risk analysis techniques.

For commercial real estate investors there are two important reasons to start using strategic risk analysis techniques. First of all, as an asset class real estate has to compete with, amongst others, equities and bonds. In the past, institutional investors often used a rule of thumb to decide on the amount of capital to invest in real estate. That is, approximately 10% was invested in real estate, and for the remaining 90% the allocation was determined by means of an ALM study. However, for more and more institutional investors this is becoming unacceptable. Institutional investors are putting more and more emphasis on quantitative founding of their strategic asset mix. Furthermore, benchmarking and performance evaluation are also becoming more important. To prevent institutional investors from (further) withdrawing from the property market, the real estate sector should be able to provide the institutional investors with reliable quantitative information on the risk-return characteristics of real estate, and on the correlation of real estate returns with other asset classes and with inflation. This information can be obtained by providing reliable real estate return series with a sufficiently long history (20 or more years) and by using strategic risk analysis techniques to calculate the characteristics of the own portfolio.

The second important reason to start using strategic risk analysis techniques is that it can provide real estate investors with essential insight into the risk – return characteristics of the current investment portfolio. Furthermore, a real estate investor can obtain insight into the relevant risk drivers (economic factors, demand / supply), in the (effectiveness of) policy instruments, the objectives, and into the connections between risk drivers, instruments and objectives. In this way, efficiency can be improved, management knows better what to do in extreme scenarios, and decisions are better founded. Strategic policy instruments available to real estate investors are, for instance, sector (residential, retail, office) / market segment allocation, country allocation, the term for new rental contracts, and the amount of leverage. The selection of individual investments is not a policy instrument at the strategic level.

In the following section, we describe the standard ALM methodology used by most Dutch institutional investors. Then, we will discuss the lack of reliable data, which is especially problematic for real estate investments, and we will discuss some potential solutions. Finally, as an example we present the results of a feasibility study performed for a large Dutch property investment company.

METHODOLOGY

We propagate the use of (Monte Carlo) simulation in order to be able to assess the risks involved in implementing a specific strategy. With simulation a large number of scenarios is generated. These scenarios are obtained by random drawing from a specific distribution. All scenarios are equally likely. With this method it is possible to take into account the interdependencies between the different variables. When a sufficient number of scenarios is

¹ An asset mix is efficient when it has the lowest possible risk given a specific return, or when it has the highest possible return given a specific level of risk.

generated, it is possible to estimate the likelihood of certain outcomes. We can actually calculate probabilities and quantify risks. With simulation it is possible to get an indication of both the expected return and the risk involved in a specific strategy. Thus, we can explicitly weigh return and risk, as for instance with the choice of the term of new loans.

We use econometric timeseries modelling to obtain a (multivariate) distribution function for the relevant economic and property market variables. The model is estimated on a dataset with historical timeseries for the variables used. The model we use guarantees that the statistical characteristics of the generated scenarios (i.e., expected values, volatility and dynamics) correspond with the statistical characteristics observed in the past (i.e., the historical timeseries used to estimate the model). This makes interpretation of the results relatively easy. Management can evaluate studied strategies in view of the historical periods that underlie the applied scenarios. We want to stress that the scenarios generated by the model should not be seen as forecasts of the future economic environment. Instead, our main goal is to test a strategy against possible / plausible future developments. The main objective of the model is to perform risk- and sensitivity-analysis. The methodology proposed here is already used by, amongst others, over 80 percent of the 50 largest Dutch pension funds, and by about 25 Dutch housing associations.

More specifically, we generate scenarios of the economic environment using a Vector Auto Regressive timeseries model of order one:

$$y_t = \alpha + \beta_1 y_{t-1} + \epsilon_t,$$

$$\epsilon_t \sim N(0, \Sigma)$$

where the notation $N(\mu, \Sigma)$ denotes a Normal (Gaussian) distribution with average μ and covariance-matrix Σ , β is a matrix containing the autocorrelation coefficients between the different timeseries, and y_t is the vector containing the applied (transformed) timeseries in year t . This approach has also been used in comparable fields like the ALM model for housing associations described by Kramer and Van Welie (2001) and the ALM model for pension funds described by Boender, Van Aalst and Heemskerk (1998).

Auto regressive of order one means that variable values in period $t + 1$ depend on (realised) variable values in period t . The underlying assumption of the model is that the realisation of *any* timeseries in year t is an explanatory variable for the distribution of *any* time series in year $t + 1$. Therefore, in this model all the timeseries serve both as independent and as dependent variable in the regression.

The estimated values of the parameters α , β and Σ , and the values y_0 of the time series in the initial period, completely specify the probability distribution for period $t = 1$. Drawing a sample point from this distribution generates a value for the vector y_1 , which in turn specifies the distribution of y_2 . Iteratively repeating this process generates a time path of vectors $\{y_t | t = 0 \dots T\}$, which is used as a scenario of the development of macroeconomic and property market circumstances. After one scenario has been generated, the process described above can be started again at $t = 1$ to generate a second scenario, etceteras.

With a very large number of draws, the means and covariances will be similar to the (theoretical) means and covariances that are specified in the distribution. To reduce the number of draws needed, the draws can be transformed in such a way that the first two moments of the distribution and the moments of the draws are exactly the same. In this way, the distributions of the economic and property market variables can be described very well, using (much) less scenarios.

THE DATA PROBLEM

To be able to use the VAR model described above, we need reliable historical timeseries. To obtain reasonable results, the absolute minimum number of (yearly) observations is 15. Twenty-five years of observations or more would, however, be better. In the ALM models for housing associations and pension funds, we usually base our scenarios on a historical period

of about 35 years. In most countries, however, there is a lack of reliable real estate return timeseries with sufficient history. In the Netherlands, for instance, the ROZ/IPD property index has been established in 1995². ROZ is investigating the possibility to generate historic timeseries back to 1982. However, up till now their efforts have not led to very promising results (see Hordijk and Voorhorst, 2000).

Within Europe, the UK has the longest running index. The publicly available UK IPD index starts from 1981. With 20 years of data, the VAR approach can be applied. One major problem with the IPD and most other indices (like the US NCREIF Property Index) is that the capital growth (i.e., indirect return) figures are based on appraisals and not on transactions. Appraisal based indices suffer from the so-called smoothing effect. Consequently, the returns are less volatile than in reality. This does not have to be a problem as long as a company bases the (balance sheet) valuation of its real estate investments on appraisals, and it has no plans to sell part of its portfolio. In reality, however, in most cases market (i.e., transaction) values are very relevant in a strategic risk analysis study. After all, virtually all property investment companies do sell off part of their portfolio from time to time. In the literature, a number of unsmoothing techniques have been proposed. These techniques try to determine the true volatility of real estate returns. See for instance Geltner and Goetzmann (2000) or Fisher, Geltner and Webb (1994). A problem with these unsmoothing techniques is that you never know whether you have obtained the true volatility.

For institutional investors, one of the reasons to invest in real estate is that direct real estate is a better inflation hedge than other investment categories. That is, direct real estate investments are supposed to have a higher correlation with inflation than equity and bonds. Indirect real estate investment returns correlate much less with inflation. The high correlation with inflation, which is often found for direct real estate, can be partly explained by rental income following inflation. Another explanation is that appraisal values usually show a higher correlation with inflation than market (transaction) values. Therefore, especially when maximising the correlation between inflation and investment return is an important management objective, the method of valuation is an important issue in a risk analysis study.

When no or not enough data are available, a possible solution is to generate so-called derived series. To generate a derived series, an average value and a standard deviation have to be specified. Also, correlations with the timeseries used in the VAR model have to be given. Of course, not all combinations of several correlations, or combinations of the standard deviation and correlations are possible. For example, it is impossible to generate a series that is perfectly correlated with both the wage inflation and a total returns bonds series, and neither can one create a series that is strongly correlated with an equity series, but which has a very low standard deviation. Correlations that are not specified implicitly follow from the correlations that are specified. Given the mean, the standard deviation and the correlations, draws from a conditional³ normal distribution are done for all years and all scenarios, after the economic scenarios have been generated.

To use a derived series for a (missing) real estate return series we have to specify the mean, the standard deviation and the correlations with the timeseries that are available. These characteristics can be obtained from different sources. First, when a timeseries is available, but not with enough history for the VAR model, we can use this timeseries to obtain the statistical characteristics. Of course, this approach would still require a significant number of (yearly) observations, but less than would be needed for direct use in the VAR model. Finally, expert opinion could be used to obtain the relevant characteristics. This approach is sometimes combined with one of the other two approaches. That is, one of the other

² ROZ/IPD measures returns to direct investment in property. The index reports total return, capital growth and income return for the property market as a whole and for the different sectors. The index represents over 80% of the value of the holdings of the financial institutions and quoted property companies.

³ That is, conditional on the scenarios.

approaches is used to obtain a first estimate of the mean, standard deviation and correlations. Then, an expert is asked to adjust the characteristics, if necessary.

AN EXAMPLE

As an example, we present the results of a feasibility study performed for a large Dutch property investment company. The composition of the investment portfolio is 35% residential, 35% retail and 30% office. The main aim of this study was to show the usefulness of the methodology described above. As the model is based on a large number of simplifying assumptions, the results should only be seen as indicative.

We use the VAR model described above to generate scenarios for the future economic environment. The following relevant historical time series were available with a sufficient number of observations (i.e., going back to 1975 or earlier):

1. Price inflation;
2. Wage inflation;
3. Interest rate on cash (i.e., 3-month treasury bills);
4. Long interest rate (i.e., effective yield on long term government bonds);
5. Gross Domestic Product;
6. Repeated sales index of house prices;
7. Supply of office space (in square metre);
8. Supply of retail space (in square metre).

These time series do not cover all relevant (macro) economic uncertainties. Missing series are, for instance, indices for the market values (i.e., indirect return) and market rents (i.e., direct return) of offices and retail. The most obvious choice for these series would be the ROZ/IPD indices. However, these indices are only available from 1995. Consequently, these indices cannot be used in the VAR model. In the following sections, we will show how we have estimated direct and indirect return on offices and retail.

Projects that will be sold off are assumed to be valued at market value. Projects that will be kept in the portfolio (at least for the coming 10 or so years) are assumed to be valued at investment value. The investment value is calculated as:

$$\text{Investment value}(t) = q * (1/d) * \text{market rent}(t)$$

Where q is a quality factor, discount factor $d = r + s$ with s = risk premium and r = real long-term risk-free interest rate. The risk premium will differ between residential, office and retail. In this study, we have assumed a risk premium of 1.5% for residential, 2.0% for retail and 2.25% for offices. The quality factor can be derived as the initial values (i.e., at $t=0$) for the investment value, the market rent and the discount factor are known. The development of investment values over time will be scenario-dependent, as both the discount factor (i.e., the real interest rate) and the market rent are scenario-dependent.

Residential portfolio

For the houses in the residential portfolio, the following information is needed at the project level: number of houses, year of construction, current rent level, current investment value, current market value, vacancy rate, sell of (yes/no) label, and operating cost prognosis. It is assumed that market rents equal the actual rents. Rents are assumed to follow inflation. The development of the market value can be determined as follows:

$$\text{Market value}(t) = \text{market value}(t-1) * \text{change in repeated sales index}(t).$$

To incorporate new investments in residential projects, the following information is needed for the coming years: per year the number of new houses acquired, the investment (acquisition costs), the net initial yield (NIY) and the expected yearly operating costs. It is assumed that new residential projects are investment projects. Furthermore, the initial market

value, initial investment value and the amount invested are assumed to be equal. Finally, given a presupposed profit margin in the NIY and a quality factor of one, the initial rent level can be derived.

Retail portfolio

For the retail portfolio, the following information is needed per rented object: the current rent, the market rent, the remaining term of the rental contract, operating cost prognosis, and investment value. As we don't have indices for the development of market values, we assume that market value equals 105% of investment value. Furthermore, we assume that when a rental contract terminates, the actual rent level is set at the market rent at that time. During the term of a contract, actual rents are assumed to follow inflation.

From an earlier study, the property investment company had available an index for the development of retail market rents. As this index only runs up to 1990, it can not be used in the VAR model. It was, however, possible to use this index to estimate a statistical relationship between retail market rents and economic timeseries that are used in the VAR model. We have run regressions between the retail market rent index and change in supply, inflation, economic growth, and the long interest rate. The best fit was obtained with the following equation:

$$\text{Real market rent growth retail (t)} = 0.016 - 0.164 * \text{change in retail supply (t-2)}$$

Thus, market rents react to developments in supply with a delay of two years. With a historical average supply increase of 5.2%, this function leads to an average real market rent increase of 0.67%. The correlation between real increase of market rents and change in supply 2 years back is -0.69. Management's expectations are that market rents will follow inflation (i.e., average real growth will be zero). In the risk analysis study, we have therefore lowered the constant in the equation such that the expected value is zero.

Vacancy rates are related to economic growth (i.e., Δ GDP). Vacancy is measured as the number of months an object remains vacant after a rental contract has been terminated. Lower economic growth leads to longer gaps between two rental contracts.

The input for future retail investments is almost equal to that for residential investments. The only additional information needed is the expected term of the rental contracts.

Office portfolio

The model for the office portfolio is almost equal to that for the retail portfolio, only the parameters are different. That is, the same input is needed; market value equals 105% of investment value; and during the term of a contract, actual rents are assumed to follow inflation during the term of a contract. Furthermore, as with the retail portfolio, vacancy rates are related to economic growth.

Office market rent indices were not available with a sufficient number of observations to run statistical regressions. We have therefore assumed that for office market rents, the same relation holds as for retail market rents. That is:

$$\text{Real market rent growth office (t)} = \text{constant} - 0.164 * \text{change in office supply (t-2)}$$

Furthermore, management's expectations are that office market rents will not be able to follow inflation for existing offices. That is, market rents for new offices will follow inflation. However, the existing office portfolio ages and will not be able to follow this development. The constant can be set such that the expected real market rent growth is in line with management's expectations.

Risk analysis

With the model described above, we can obtain prognoses for profit & loss accounts, balance sheets and cash flows, both for the company as a whole as for the different portfolios (residential, retail and office). Each scenario from the VAR model leads to another prognosis

for the financial statements. In this study we have worked with 200 scenarios. This leads to 200 prognoses for the financial statements and thus also for direct, indirect and total returns. Therefore, with these 200 prognoses we can obtain estimates of the probability distributions for the returns. With these probability distributions, we can test whether certain objectives are met given a strategy specified by management.

The management has specified the following objectives:

- ?? Maximisation of average total return;
- ?? Minimisation of the standard deviation of the total return (i.e., maximum predictability);
- ?? Maximisation of the correlation between total return and inflation⁴;
- ?? Minimisation of the probability that the total return drops below 4%.

In the first stage of this study, we have looked at the risk-return characteristics⁵ of the current strategy of the company. In the second stage, we have analysed the sensitivity of the results to changes in the proportion of new investments allocated to residential, retail and office and to changes in the term of new rental contracts.

Figure 1 (top row) shows scenario clouds for total, direct and indirect return for the base case, the current management strategy. A scenario cloud presents the development over time of one specific variable for each individual scenario. With 200 scenario's, this leads to a 'cloud' of 200 lines showing the development of the variable over time. In this example: from 1998 to 2006. In the figure, each yellow line represents one individual scenario. The red line represents the average over all 200 scenarios. The blue line highlights one specific individual scenario.

<Take in Figure 1>

The three return scenario clouds in the top row of figure 1 all have the same dimensions (vertical axis: -8% to +20%, horizontal axis: year 1998 to 2006). We can see that virtually all uncertainty (or volatility) in the total return arises from uncertainty in the indirect return.

For an investment company, it is useful to know the external variables it is sensitive to. This knowledge can be used to look for possible ways to reduce (extreme) sensitivity. As an example, the blue line in the total return scenario cloud represents a scenario with below-average returns over the entire simulation horizon. This same scenario (scenario 54, as can be seen in the square brackets) is also marked in the other scenario clouds. We can now see that this below-average total return coincides with dropping house prices (house price increase remains below zero over the entire horizon), high real interest rates (and thus low investment values) and low price inflation (or even deflation, leading to low, or no, rent increases).

The scenario clouds can be used to extract risk and return measures. A risk-return field can then be used to compare strategies on the dimensions risk and return. From the objectives defined by management we can deduce the following risk and return measures: average total return, average correlation with inflation, standard deviation of total return, and the probability that total return drops below 4%. In figures 2, 3 and 4 we show risk-return fields for the allocation of new investments to the sectors (residential, retail or office). The following strategies have been analysed (the percentages between brackets report the resulting allocation to residential, retail and offices in 2006):

1. Base case (45%; 30%; 25%);
2. Only new residential investments (84%; 5%; 11%);
3. Only new retail investments (18%; 71%; 11%);

⁴ First calculating the correlation over the simulation horizon (in this case 1998-2006) for each scenario, and then taking the average over the 200 scenarios determines the correlation between total return and inflation.

⁵ The risk-return characteristics specify whether or not an objective has been realised.

4. Only new office investments (18%; 5%; 77%);
5. No new investments (30%; 42%; 28%).

<Take in Figure 2>

In all three figures, the average total return is on the horizontal axis. In Figure 2, the average correlation with inflation is on the vertical axis. In this case, management would be interested in strategies maximising the values on both axes. Therefore, only the base case and investing in retail or residential are efficient strategies given the current measures. Investing in residential (strategy 2) leads to the highest correlation with inflation (41%), but also to the lowest average total return (9.6%). Investing in retail (strategy 3) leads to the highest average total return (10.2%) but has a lower correlation with inflation (35%).

<Take in Figure 3>

In Figure 3, the standard deviation of total return is on the vertical axis. Management wants to minimise this risk measure. With the current risk and return measures, investing in residential no longer is efficient. Instead, investing in offices (strategy 4) has become efficient. Finally, in figure 4 the probability of a total return below 4% is on the vertical axis. With this risk measure, only investing in retail remains efficient.

<Take in Figure 4>

From these figures we can conclude that the 'best' strategy depends on the risk and return measures chosen. It is up to the management to decide which measures are most relevant to them. Given a choice for the risk and return measures, the management can quantitatively found the strategic choices made. First, non-efficient strategies can be identified. Then, an acceptable range has to be defined for the risk and for the return measure. Within this acceptable range, the final strategy can be chosen from the set of efficient strategies.

By presenting strategies in risk-return fields like the ones presented above, it is very easy to compare the strategies in terms of both expected return and risk. Furthermore, acceptable and non-acceptable strategies can be easily distinguished. Finally, it is also possible to analyse the effectiveness of instruments. If we define different strategies that only differ in one specific instrument, we can derive the impact of this instrument by looking at the differences between the strategies in the risk-return field. When we compare different strategies where different instruments are adjusted relative to the default, we can determine the relative impact of the instruments.

CONCLUSIONS

We propagate the use of scenario analysis by means of simulation to perform strategic risk analysis studies. This approach can provide the management of property investment companies with essential insight into the companies' risk-return profile, the relevant risk drivers, and into the (relative) effectiveness of the policy instruments available to them. Furthermore, it can lead to an improved, integral, management of the company. With this approach, strategic choices can be founded. Furthermore, this approach can be used to justify and communicate the choices to the stakeholders (such as shareholders and employees).

The results presented in the example are very preliminary. The main aim of the study was to show the usefulness of the approach. The reliability of the results will heavily depend on the quality of the timeseries used in the VAR model. In countries with sufficient (reliable) real estate timeseries, our approach can be applied easily. In most countries, however, a lot of work still has to be done in the field of timeseries construction. However, in order to compete with other investment classes like equity and bonds, it is essential for the property market as a whole to have reliable direct and indirect return timeseries. After all, institutional investors are putting more and more emphasis on quantitative founding of strategic choices. Benchmarking and performance-evaluation are also getting even more important. The property market cannot afford to stay behind.

REFERENCES

- Boender, C. G. E., Van Aalst, P. C., and Heemskerk, F. (1998), "Modelling and Management of Assets and Liabilities of Pension Plans in The Netherlands", in *World Wide Asset and Liability Modeling* (W. T. Ziemba, and J. M. Mulvey, Eds.), pp. 561-580, Cambridge University Press.
- Fisher, J. D., Geltner, D. M., and Webb, R. B. (1994), "Value Indices of Commercial Real Estate: A Comparison of Index Construction Methods", *The journal of real estate finance and economics*, vol.9, nr.2, pp. 137-164.
- Geltner, D., and Goetzmann, W. (2000), "Two Decades of Commercial Property Returns: A Repeated-Measures Regression-Based Version of the NCREIF Index", *The journal of real estate finance and economics*, vol.21, nr.1, pp. 5-21.
- Hordijk, A., and Voorhorst, J. (2000), "Developing historical time series in a market without external market valuations", paper presented at the 7th European Real Estate Society Conference, Bordeaux (France), June 2000.
- Kramer, B., and Van Welie, T. (2001), "An Asset Liability Management Model for Housing Associations", *Journal of Property Investment & Finance*, forthcoming.

Figure 1: Scenario clouds for the base case, 200 scenarios

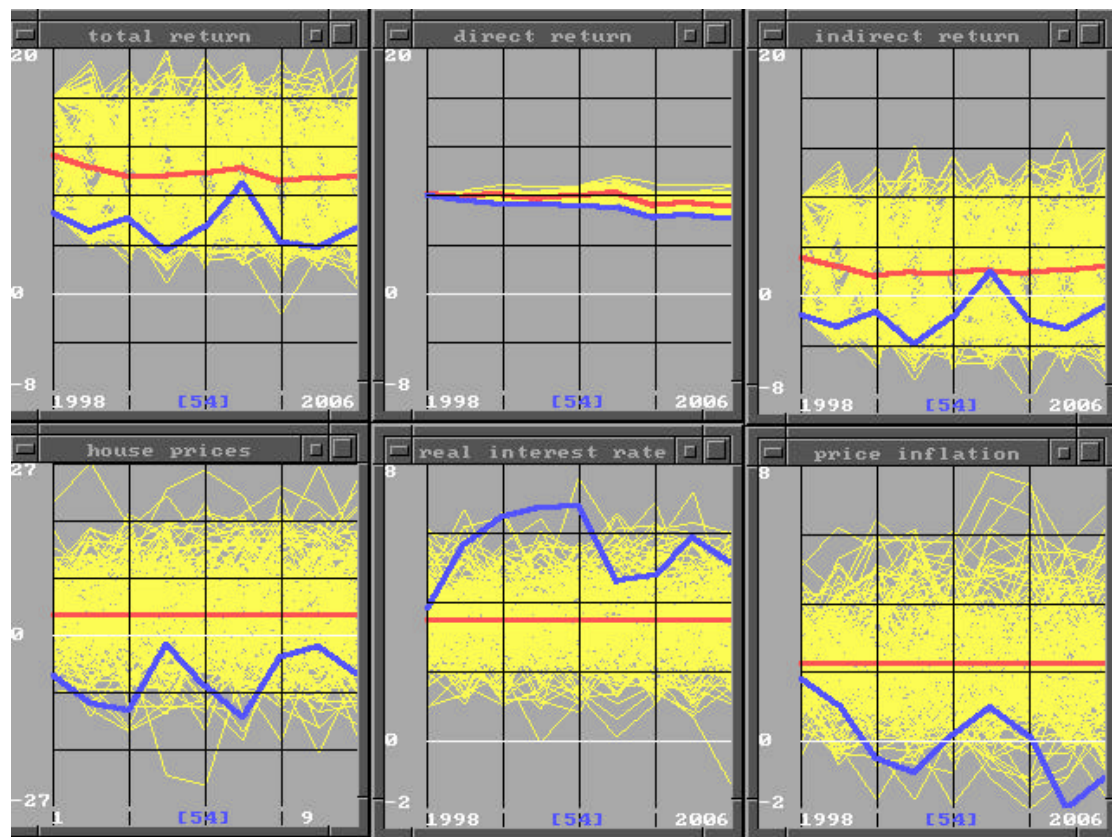


Figure 2: Risk-return field for new investment allocation, average correlation with inflation

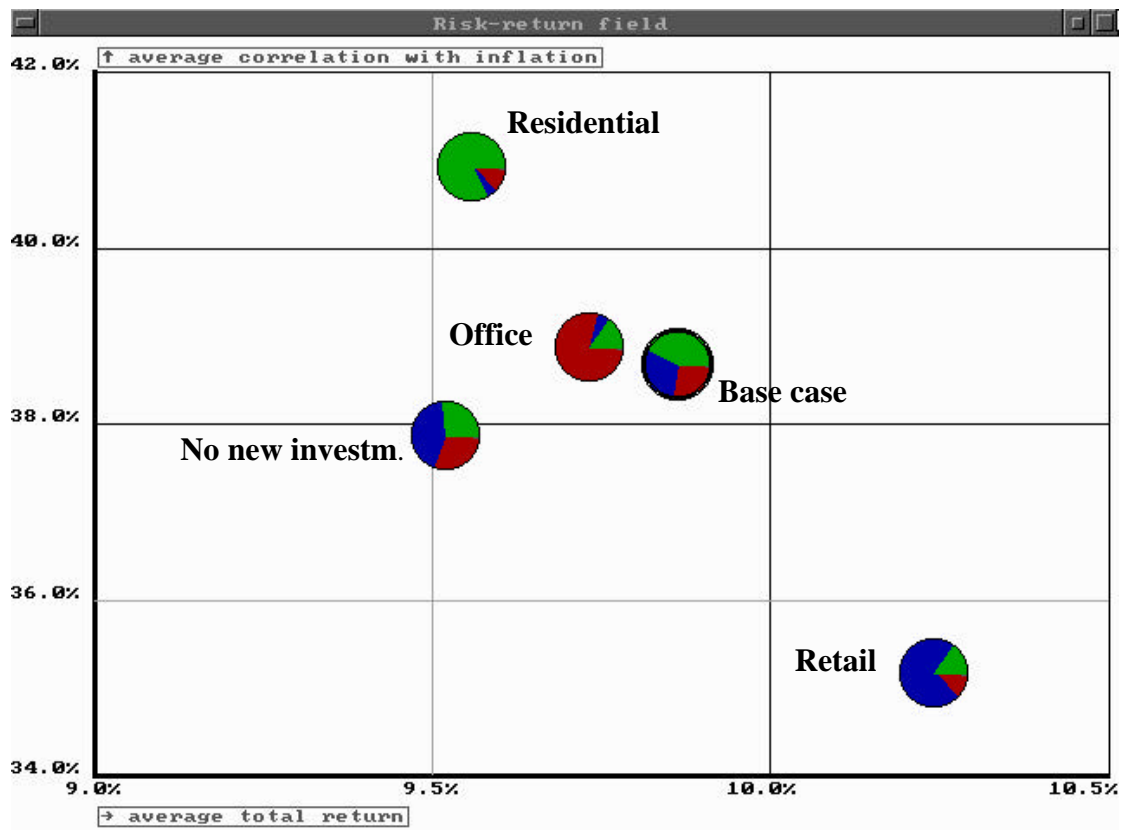


Figure 3: Risk-return field for new investment allocation, standard deviation of total return

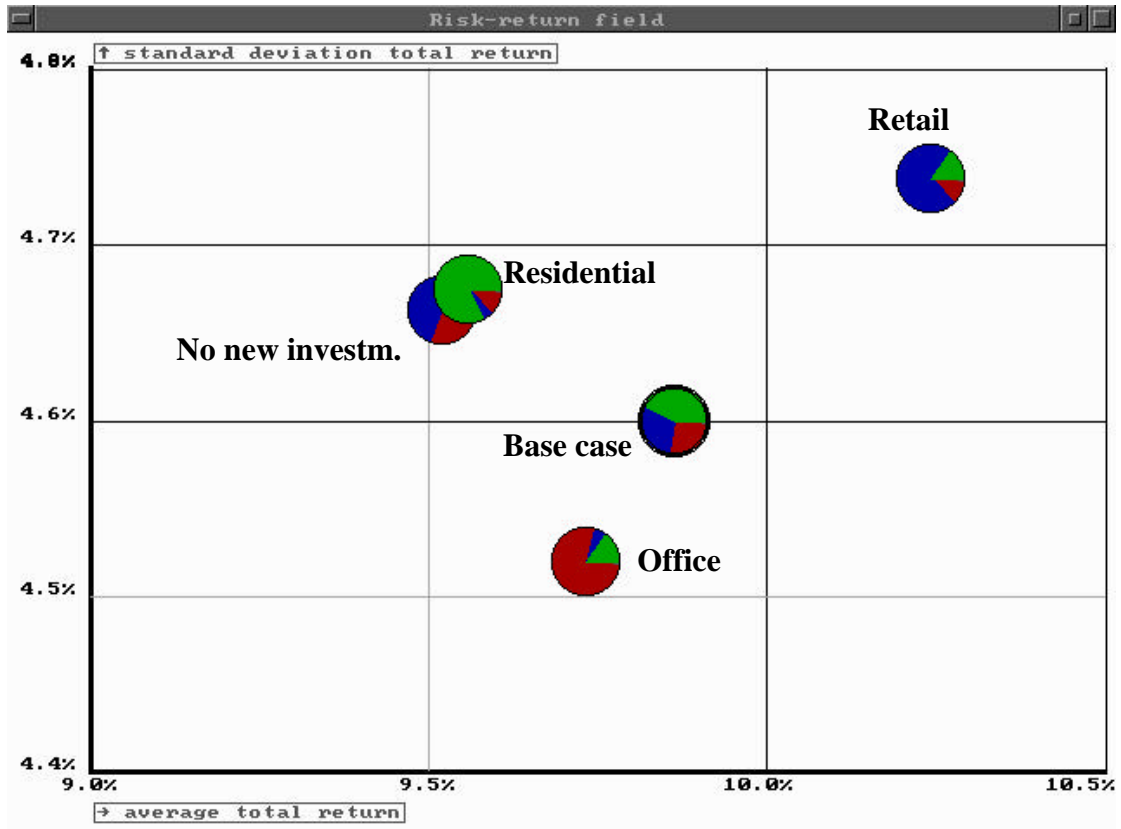


Figure 4: Risk-return field for new investment allocation, probability that total return drops below 4%

