Diversification Benefits from European Direct Real Estate Investments with a Special Focus on the German Market

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Content:

A. Concept of Diversification - Spreading Specific Risk

Besides the specific return and risk variables of individual assets within a portfolio the correlation of returns between the individual assets are of relevance for the portfolio risk. Capital market theory suggests that diversification effects develop from return correlations with a correlation coefficient of lower than 1. Through the separation of systematic and unsystematic risk in a portfolio the combination of two assets with returns not completely positive correlated results in a risk reduction. Systematic risk represents the market risk, which affects equally all assets on all markets considered. Consequently, it can not be diversified away by spreading risk. Unsystematic risk, however, affects only specific assets, asset classes or homogenous sub-markets. It is related to the individual assets and with that the risk of the total portfolio may be balanced by a spreading different assets and their returns correlating as negative as possible. As shown in the graph below it decreases with an increasing number of assets in a portfolio.

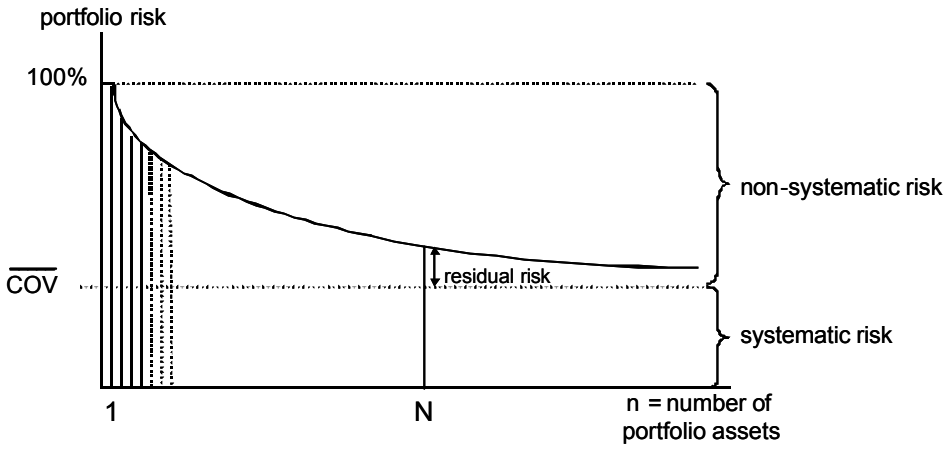

Figure 1: Reduction of Portfolio Risk depending of the number of Assets within the Portfolio

Unsystematic risk may theoretically be diversified away completely. As a result the assumption of systematic risks leads to risk premiums. Unsystematic risks, however, are not remunerated.[1]

B. Evidence of Diversification Effects on Real Estate Portfolios

As shown in the graph below numerous studies provided evidence that the above described diversification effects may also be applied to real estate portfolios.[2]

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1 Sanders / Pagliari / Webb, Portfolio management concepts, 1995, p. 130.

2 Hartzell / Shulman / Wurtzebach, Regional diversification, 1987; Firstenberg / Wurzebach, Managing Portfolio, 1989; Malizia / Simons, Regional portfolio diversification, 1991; Mueller / Ziering, Real Estate Portfolio Diversification, 1992; Mueller, Economic diversification, 1993; Wurtzebach, Real Estate Portfolio Management, 1994; Eichholtz et al., Portfolio diversification, 1995; Arnold / Grossman, International Real Estate, 1995; Ziering / Hess, Diversification, 1995; Williams, Portfolio diversification, 1996; Rabianski / Cheng, Intrametropolitan diversification, 1997; Wolverton / Cheng / Hardin, Intracity Diversification, 1998; Brown / Li / Lusht, Intracity Geographic diversification, 2000; Viezer, Diversification Strategies, 2000; Nelson / Nelson, Regional Models (a), 2000; Fisher / Liang, Diversification, 2000; Jandura / Rehkugler, Anwendung der MPT, 2001; Nelson / Nelson, Regional Models (b), 2002 and Wellner, Entwicklung eines Immobilien-Portfolio-Management-Systems, 2003.

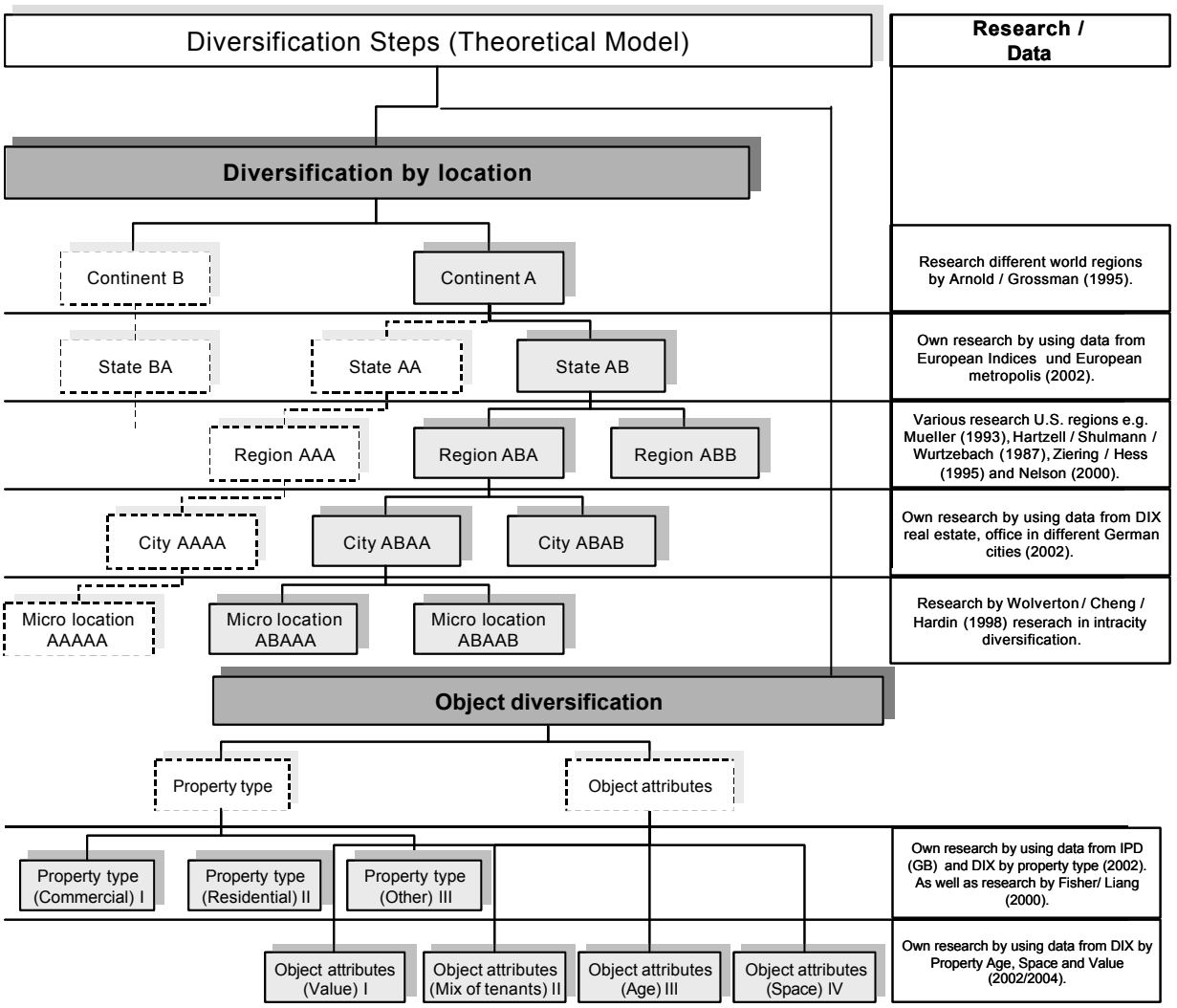

Figure 2: Levels of Diversification

The objective of this study is to demonstrate the possibilities of active risk management through the diversification of direct investments in real estate on the basis of empirical data with a special focus on European markets and here especially on the German market. As a result of this objective the risk reduction potentials of European and German Markets are examined.

The study aims to show that diversification potentials increase with the size of the chosen relevant market. Consequently, greater potentials for risk reduction more likely result from international diversification than from national or regional diversification. The differentiation in systematic and unsystematic risk provides an explanation for this phenomenon. On an international market the systematic risk is lowest; because only few influencing factors remain which equally affect all objects worldwide as for example the economic activity of the world market. Regional influences such as national taxes or specific regional developments of the property market then count as unsystematic risks (see Figure 3).

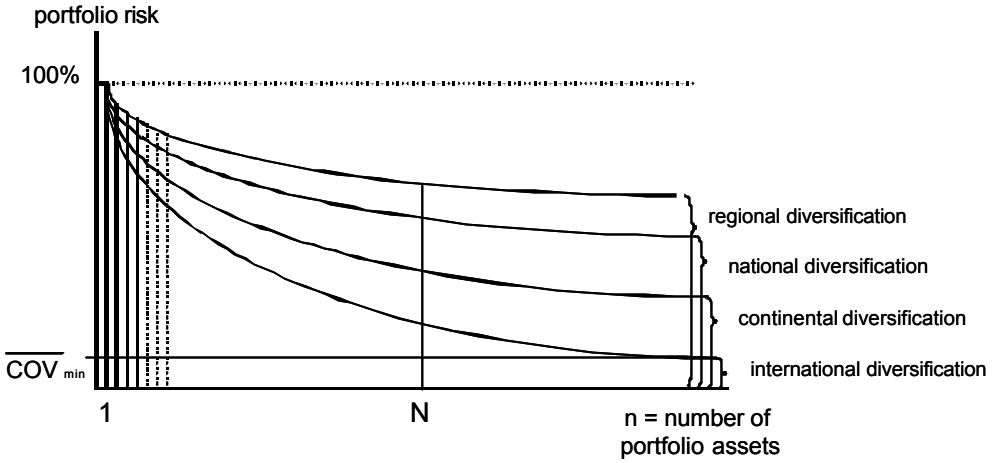

Figure 3: Effects of international vs. Regional diversification on systematic risk

Not only will the diversification of locations be examined, but also the diversification of other property characteristics - since for the determination of unsystematic risks, besides location, also other parameters are of relevance and determine the risk return relation of real estate investments. Those parameters include for example property types as well as the individual property sector, elements of financing, the market situation, management, lease situation and technical aspects as well as age and size.[3] Through a specific mix of those factors in the portfolio together with the various combination possibilities (see Figure 4) risks may be diversified.

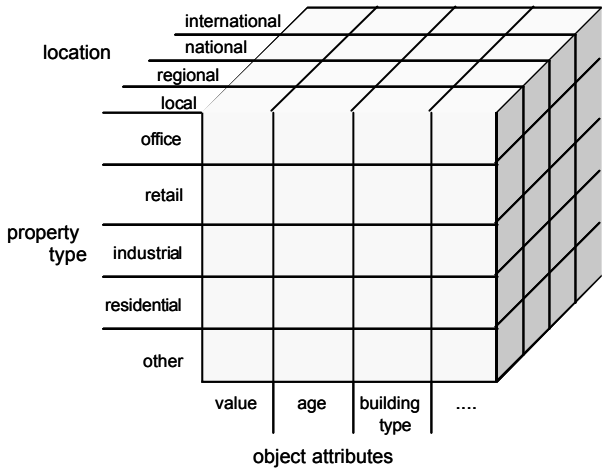

Figure 4: Possible Diversification Combinations of Location, Type and Attribute[4]

An essential prerequisite for the portfolio selection of real estate is the development of homogeneous classes of investment, e.g. according to locations or types of use.[5] On one hand the homogeneity within a defined market must be assured, but also heterogeneity between the different markets is required i.e. the correlation should be as low as possible or even negative.[6] This study

3 Eastman / Hudson-Wilson, Portfolio Management, 1993, p. 634.
4 See e.g. Del Casino, Portfolio Diversification Considerations, 1995, p. 915.
5 Schulte / Walbröhl, Asset Management, 2002, p. 668f.
6 Rabianski / Cheng, Intrametropolitan diversification, 1997, p. 117.

will show at the example of the European and the German market, which combinations of factors provide the most efficient opportunities for the investor targets concerned.

C. Empirical Analysis

Characterization of the used data:

The property indices of various European countries are the basis for this study. This includes the IPD UK Annual Index, the IPD/SCS Ireland Index, the DIE/IPD Denmark Index (from 2000), the IPD France Index (from 1998), the DIX German Index (from 1996), the SFI / IPD Sweden Index (from 1997), the ROZ / IPD Netherlands Index, the IPD Norway Property Index (from 2000), the IPD Portugal Property Index (from 2000) and the KTI Index Finland (from 1998).

A number of statistical series are only available, however, for a relatively short time-span. Consequently, the results of this research have to be treated as preliminary research. All indices are all calculated on the basis of the IPD „total return" formula and are available through a cooperation of the various data banks within the IPD framework.[9]

On the basis of individual properties the German index is the main focus of analysis. Since 1996 the DID Deutsche Immobilien Datenbank GmbH has provided the German Index DIX with increasing market coverage.[10] In 2002 the data bank of DID, which represents the data basis for the DIX, included more than 2000 properties with a total value of approx. €35bn. of which 60% are offices. At present the index represents approximately 30 to 35% of the German institutional market.

I. Analytical Methodology

In the following it will be principally distinguished between location specific and property specific diversification. Their different potential will be shown via the calculation of their risk return profile.

In order to have comparable results, an identical approach was chosen. The returns of the chosen sub-market are derived from the total return formula. As a result they represent income return plus capital growth. From the return time series the historic annualised total return and the standard deviation is calculated for each analysed sub-market. Additionally the correlations between the returns are determined. These calculations represent the basis for the determination of the efficient frontier and the optimal portfolio weightings on the basis of the portfolio risk return formula.

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7 Schulte / Walbröhl, Asset Management, 2002, p. 668f.

8 Rabianski / Cheng, Intrametropolitan diversification, 1997, p. 117.

9 www.ipdindex.co.uk.

10 For more background information on the DIX German property index see Thomas, Performancemessung, 2002, p. 694f.

$$E(R) = \mu = \sum_{i=1}^{N} x_i E(r_i) \quad ; \qquad \sigma_p^2 = \sum_{i=1}^{N}\sum_{k=1}^{N} x_i x_k \sigma_i \sigma_k c_{ik}$$

With $E(R)$ = *Expected Return of Portfolio,*

$E(r_i)$ = *Expected Return of Asset i,*

$x_i; x_j$ = *Weighting of Assets i and j within the Portfolio,*

σ_p = *Standard Deviation of Portfolio Return,*

$\sigma_i; \sigma_j$ = *Standard Deviation of Return of Assets i and j,*

c_{ik} = *Correlation Coefficient between Return of Asset i and k,*

Equation 1: Calculation of Expected Return and Risk of a Portfolio[11]

The risk return diagram provides an infinite set of combinations for portfolio compositions within the μ - σ - framework. For an investor, however, only efficient portfolios on the efficient frontier are of interest. The appropriate optimal weightings of the respective portfolio components are determined using an iteration method and are shown in the weightings graph.

Yet not only one efficient portfolio exists, but an infinite number of combinations to which this definition applies. As a result all efficient portfolios can be found on the efficient frontier. For all portfolio combinations on the efficient frontier it is true that all other possible combinations on the curve either include a return reduction in combination with an equal risk or a risk increase in combination with an equal return. The Minimum-Variance-Portfolio (MVP) and the Maximum-Return-Portfolio (MRP) represent the ends of the efficient frontier.

In order to identify an optimal combination from all portfolios on the efficient frontier the Sharpe Ratio-Maximum (SRM) was chosen.[12] The Sharpe Ratio represents the best possible risk-return-ratio in the portfolio defined as the excess return (based on the risk-free interest rate R_f) per unit of risk.[13]

$$SR_P = \frac{R_p - R_f}{\sigma_p}$$

Equation 2: Sharpe Ratio (SR)[14]

It must be pointed out, that Sharpe Ratios for portfolio returns lower than the risk-free interest rates can not be used in this framework.

The current yields of fixed-income securities of German bond issuers with a term to maturity of four years were defined as risk-free interest rates. The return was chosen according to the period of the index calculation hence equivalent to the relevant start-year and number of years. For the European Indices a market average at 1998 of 4.5% p. a. was calculated (the starting point of the

11 Spremann, Portfoliomanagement, 2000, p. 144. and Hielscher, Investmentanalyse, 1999, p. 57.
12 Liang / McIntosh, Sharpe's Alpha, 1998, p. 13.
13 Cheng / Liang, Optimal Diversification, 2000, p. 8.
14 Sanders / Pagliari / Webb, Portfolio management concepts, 1995, p. 142.

return time series for the analysis of the European diversification effects). For the analysis of the German market the figure at 1996 (the base year of the DIX Deutscher Immobilien Index) of 5.6% p.a. was chosen. Inflation rates or potential currency risks were not considered.

For the MVP, MRP and SRM, but also for a naive diversification with equal weightings the individual return, risk as well as the optimal weightings of the portfolio were calculated. This analysis is followed by a second examination of the indicators this time restricted to a maximum of 25% of the total portfolio value. As Markowitz's optimisation model is criticized heavily due to its mathematical and statistical limits in its practical application and since the naive equal weighting of markets often produces equally good results due to the uncertainty of future market developments[15], the restriction to 25% is more accurate than a one-to-one construction of a model portfolio. In addition the danger of an extrapolation from ex post-values to future developments may be prevented through the incorporation of a constraint alternative of the naive diversification.

The diversification potential of the individual diversification levels will be demonstrated through various analyses.

II. Diversification by Locations

Location diversifications are considered, besides the sectoral spread of a portfolio, as the most successful diversification factor since property markets are differentiated by various sub-markets, which may develop differently even concerning identical types of use.

a) International or Intra-continental Diversification

Within the locational diversification the international diversification looks most promising, as here the systematic market risk, which is restricted to global economy influences, is lowest. International diversification can be distinguished further in inter- and intra-continental diversification. Here the intercontinental diversification is to favoured, as also countries on the same continent may be exposed to comparable impacts e.g. a unified currency area or trade zone, but also for example have a similar climate. [16] It must be pointed out that the benefits must be in relationship to the cost for the data collection, hedges against currency risks [17], but also in relation to the transaction costs of the implementation of the diversification strategy.[18]

As already mentioned an empirical study of these categories has been conducted on the basis of data from the IPD homepage for all European indexes available. The following diversification effects are the results of the study of the years 1998 to 2002 (for Portugal, Norway and Denmark the missing return time series were substituted by the relevant national means).

As besides the individual return expectations and standard deviations, also the correlation between the returns is of importance for diversification, this correlation is examined in a first step.

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15 Compare with results of Cheng / Liang, Optimal Diversification, 2000, p. 7.

16 Eichholtz / Huismann / Koedijk / Schuin, Continental Factors, 1998, p. 493.

17 Exchange rate risk has been terminated with the introduction of the EURO within the EUROZONE and is only of importance for few markets relevant for German institutional investors.

18 Lizieri / Finlay, International property portfolio strategies, 1995, p. 8f.

Correlation	Ireland	Sweden	United Kingdom	Nether-lands	France	Denmark	Germany	Norway	Portugal	Finland
Ireland	**1**	0,87	0,70	0,86	0,05	0,01	0,12	0,56	-0,59	0,98
Sweden	0,87	**1**	0,63	0,97	0,48	-0,10	0,30	0,71	-0,86	0,78
United Kingdon	0,70	0,63	**1**	0,60	0,22	-0,43	-0,41	-0,02	-0,38	0,64
Netherlands	0,86	0,97	0,60	**1**	0,53	0,12	0,44	0,78	-0,73	0,77
France	0,05	0,48	0,22	0,53	**1**	-0,01	0,44	0,44	-0,50	-0,13
Denmark	0,01	-0,10	-0,43	0,12	-0,01	**1**	0,77	0,52	0,37	0,04
Germany	0,12	0,30	-0,41	0,44	0,44	0,77	**1**	0,87	-0,22	0,06
Norway	0,56	0,71	-0,02	0,78	0,44	0,52	0,87	**1**	-0,60	0,49
Portugal	-0,59	-0,86	-0,38	-0,73	-0,50	0,37	-0,22	-0,60	**1**	-0,48
Finland	0,98	0,78	0,64	0,77	-0,13	0,04	0,06	0,49	-0,48	**1**

Figure 5: Correlation of various European Return Series[19]

The highest correlation is between Finland and Ireland with 0.98, which indicates a parallel return movement. The highest negative correlation with -0.86 is between Sweden and Portugal, which suggests a high risk reduction potential. The Portuguese returns are correlated negative to most other markets and are thus attractive for constructing efficient portfolios.

Figure 6 demonstrates that the efficient portfolios show a return from 8.1% to 18.9% (difference = 10,8 percentage points) and a risk from 0.3% to 13.1% (difference = 12.8 percentage points). In addition chart 3 in Figure 6 shows the appropriate weighting of each individual location. The calculation shows that optimal portfolios almost completely consist of a mix of properties in Portugal and Ireland depending on their risk return level. The risk maximum is at 100% Ireland with a return of 18.95% with a standard deviation of 13.12%. A highly risk-averse investor would also hold German, British and Swedish properties, whilst a less risk-avers investor would mainly hold Portuguese properties. Ireland would offer properties for investors interested in return maximisation.

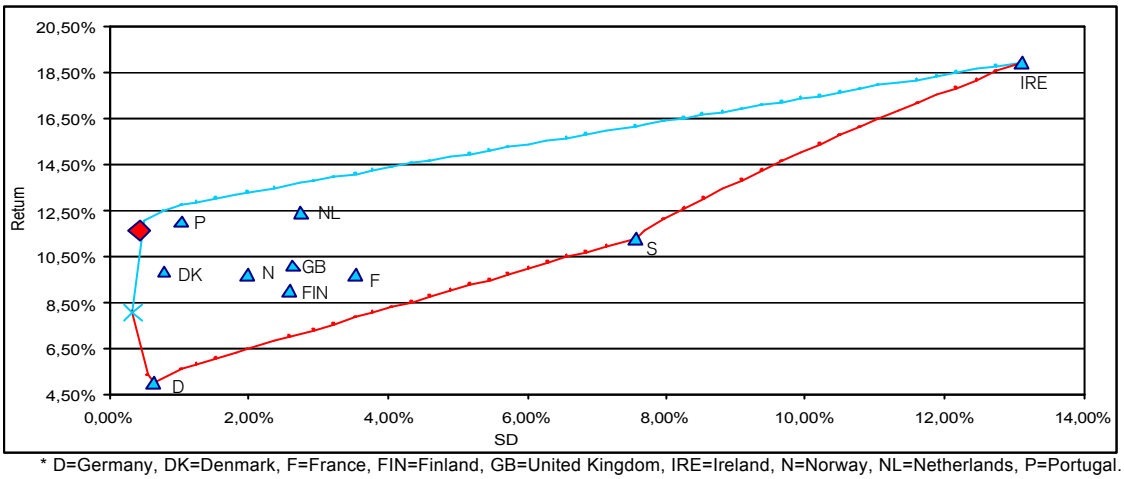
The naive equal weighting portfolio (10.8; 2.8) produces a reasonable risk reduction in comparison to an exclusive investment in high-risk locations like Ireland and Sweden, but are to be rejected as inefficient as an investment with the Sharpe Ratio-Maximum (shown as red rhombus on the efficient frontier) offers a slightly higher return, but with a significantly lower risk (11.6; 0.4)

[19] Calculated on the basis of data provided by IPD Investment Property Databank, London, 2003.

Results of the Portfolio 1: European Country Indexes, Source: IPD 2003

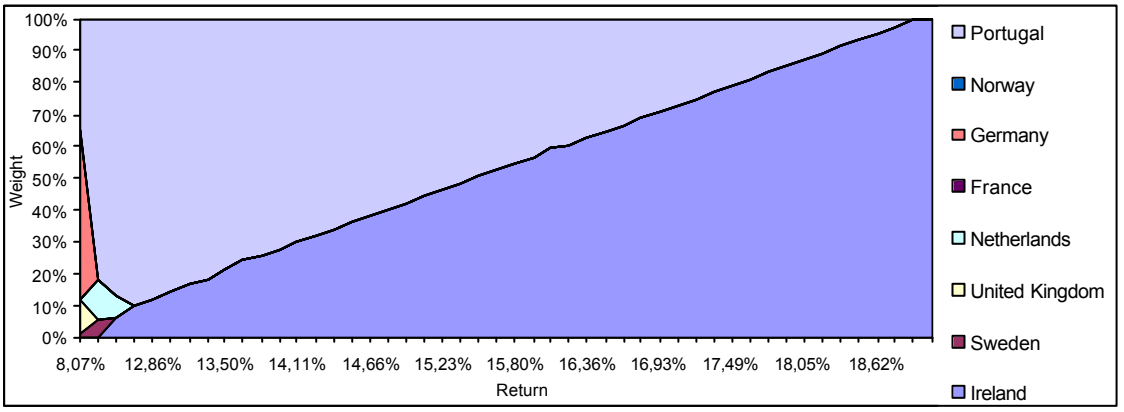
Results			Portfolio max. 100%	Risk min.	Return max.	Sharpe Ratio max.	Equal weighted	Portfolio max. 25%	Risk min.	Return max.	Sharpe Ratio max.
			Portfolio Mean	**8,07%**	**18,95%**	**11,60%**	**10,80%**	**Portfolio Mean**	**9,24%**	**13,67%**	**9,24%**
			Portfolio SD	**0,34%**	**13,12%**	**0,44%**	**2,86%**	**Portfolio SD**	**0,48%**	**5,47%**	**0,48%**
Assets	**Mean**	**SD**	**Sharpe Ratio**	**10,5000**	**1,1014**	**16,1364**	**2,2028**	**Sharpe Ratio**	**9,8750**	**1,6764**	**9,8750**
				Weights					***Weights***		
Ireland	18,95%	13,12%	Ireland	0,00%	100,00%	0,00%	10,00%	Ireland	0,00%	25,00%	0,00%
Sweden	11,34%	7,56%	Sweden	0,67%	0,00%	8,90%	10,00%	Sweden	0,00%	25,00%	0,00%
United Kingdom	10,09%	2,63%	United Kingdom	11,13%	0,00%	0,00%	10,00%	United Kingdom	16,65%	0,00%	16,65%
Netherlands	12,35%	2,74%	Netherlands	0,00%	0,00%	0,00%	10,00%	Netherlands	0,00%	25,00%	0,00%
France	9,68%	3,54%	France	0,00%	0,00%	3,43%	10,00%	France	0,98%	0,00%	0,98%
Denmark	9,83%	0,79%	Denmark	0,00%	0,00%	0,00%	10,00%	Denmark	25,00%	0,00%	25,00%
Germany	4,99%	0,63%	Germany	53,16%	0,00%	3,51%	10,00%	Germany	24,23%	0,00%	24,23%
Norway	9,68%	1,98%	Norway	0,00%	0,00%	2,09%	10,00%	Norway	8,14%	0,00%	8,14%
Portugal	12,04%	1,05%	Portugal	35,05%	0,00%	82,08%	10,00%	Portugal	25,00%	25,00%	25,00%
Finland	9,03%	2,59%	Finland	0,00%	0,00%	0,00%	10,00%	Finland	0,00%	0,00%	0,00%
			Total	**100%**	**100%**	**100%**	**100%**	**Total**	**100%**	**100%**	**100%**

Efficient Frontier*



* D=Germany, DK=Denmark, F=France, FIN=Finland, GB=United Kingdom, IRE=Ireland, N=Norway, NL=Netherlands, P=Portugal.

Optimal portfolio weights: weighting max. 100%



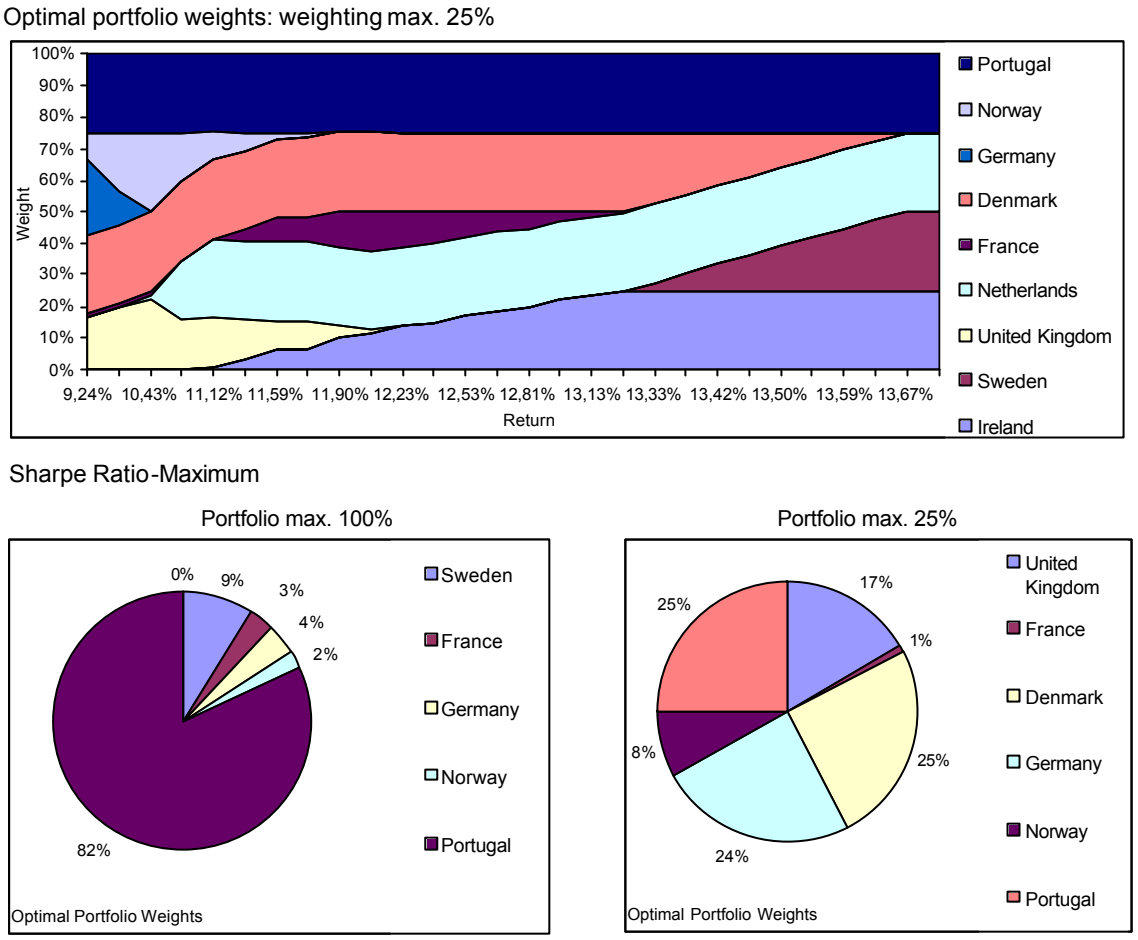


Figure 6: **Efficient frontier and weightings of a portfolio with a combination of various European countries**[20]

The optimal portfolio restricted to a maximum weighting of 25% includes Germany, the UK, Denmark, Norway and Portugal in the risk-minimum sector and of a weighting of 25% each of Portugal, the Netherlands, Sweden and Ireland in the return-maximum. The SRM is well distributed over 6 locations (see Figure 6) and is recommendable for the rational investor.

b) Intra-national or Regional Diversification

The diversification across different locations within a country represents a lower diversification potential because the systematic market risks are significantly higher. All property investments within one country are influenced by equal cyclical developments, are exposed to (in general) equal taxation and to a similar level of interest rates. Slight deviations in those variables (e.g. communities with varying real property taxes, regionally different cyclical developments) provide only marginal diversification potential. Federalistic states as the US and Germany provide more potential than centralistic systems.

Regional diversification potential often arises from differing developments of congested urban areas in comparison to rural areas or from a strong economic disequilibrium within a country as for example the North-South divide in Italy or the East-West differences in Germany. The varying

20 Calculated on the basis of data provided by IPD Investment Property Databank, London, 2003.

cyclical developments of the individual regions provide diversification potentials through regional portfolio spread.[21]

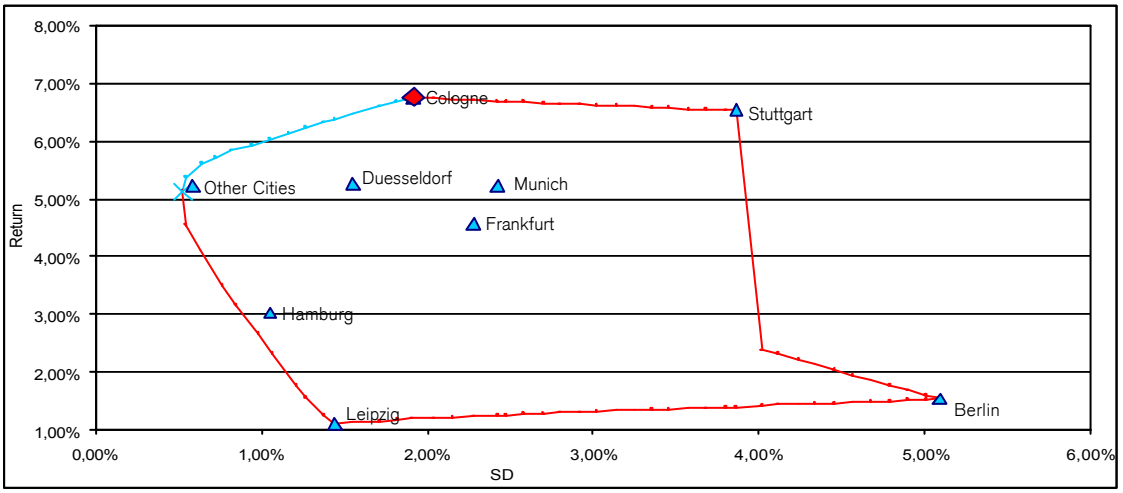
An analysis of diversification potentials within Germany was conducted for office returns in major German cities on the basis of DIX data for the years 1996 to 2002. The correlation coefficients show relatively different relations with a high similarity between Hamburg, Leipzig and Berlin with figures between 0.5 and 0.9 and almost a dissimilarity between Stuttgart and Berlin with –0.85.

The average return and the related risks are very different. Leipzig and Berlin show the lowest returns in relation with a simultaneously high risk in Berlin for example (see Figure 7). This results in an interesting mix within the portions of the more efficient portfolios for the time period concerned:

Results of the Portfolio 2: German Cities, Commercial Properties , Source: DID 2003

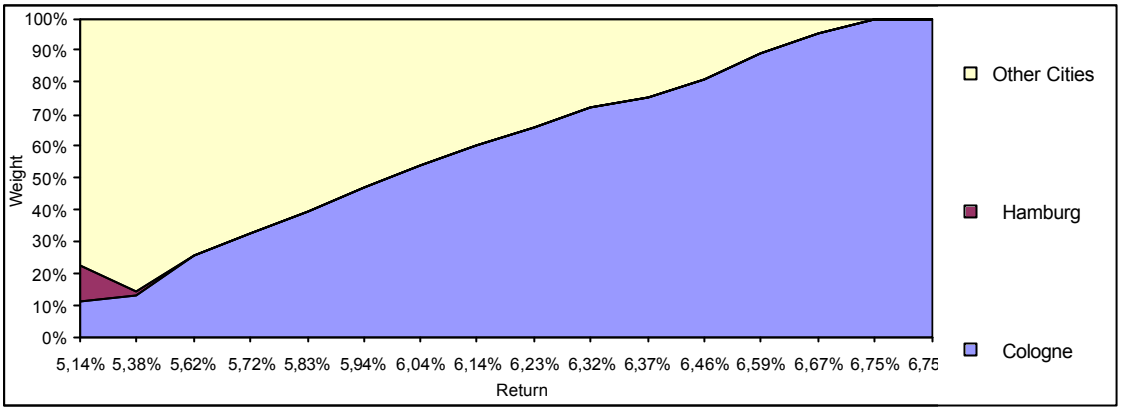
Results			Portfolio max. 100%	Risk min.	Return max.	Sharpe Ratio max.	Equal weighted	Portfolio max. 25%	Risk min.	Return max.	Sharpe Ratio max.
			Portfolio Mean	**5,14%**	**6,75%**	**6,75%**	**4,36%**	**Portfolio Mean**	**4,91%**	**5,95%**	**5,95%**
			Portfolio SD	**0,52%**	**1,91%**	**1,91%**	**1,05%**	**Portfolio SD**	**0,70%**	**1,50%**	**1,50%**
Assets	**Mean**	**SD**	**Sharpe Ratio**	**-0,8846**	**0,6021**	**0,6021**	***-1,1810***	**Sharpe Ratio**	**-0,9857**	**0,2333**	**0,2333**
				Weights					***Weights***		
Frankfurt	4,56%	2,28%	Frankfurt	0,00%	0,00%	0,00%	11,11%	Frankfurt	0,00%	0,00%	0,00%
Berlin	1,54%	5,09%	Berlin	0,00%	0,00%	0,00%	11,11%	Berlin	5,25%	0,00%	0,00%
Munich	5,23%	2,42%	Munich	0,00%	0,00%	0,00%	11,11%	Munich	0,00%	0,00%	0,00%
Cologne	6,75%	1,91%	Cologne	10,85%	100,00%	100,00%	11,11%	Cologne	25,00%	25,00%	25,00%
Duesseldorf	5,27%	1,55%	Duesseldorf	0,00%	0,00%	0,00%	11,11%	Duesseldorf	16,79%	25,00%	25,00%
Hamburg	3,03%	1,05%	Hamburg	11,56%	0,00%	0,00%	11,11%	Hamburg	25,00%	0,00%	0,00%
Stuttgart	6,53%	3,86%	Stuttgart	0,00%	0,00%	0,00%	11,11%	Stuttgart	2,96%	25,00%	25,00%
Leipzig	1,13%	1,44%	Leipzig	0,00%	0,00%	0,00%	11,11%	Leipzig	0,00%	0,00%	0,00%
OtherCities	5,23%	0,59%	OtherCities	77,59%	0,00%	0,00%	11,11%	OtherCities	25,00%	25,00%	25,00%
			Total	**100%**	**100%**	**100%**	**100%**	**Total**	**100%**	**100%**	**100%**

Efficient Frontier

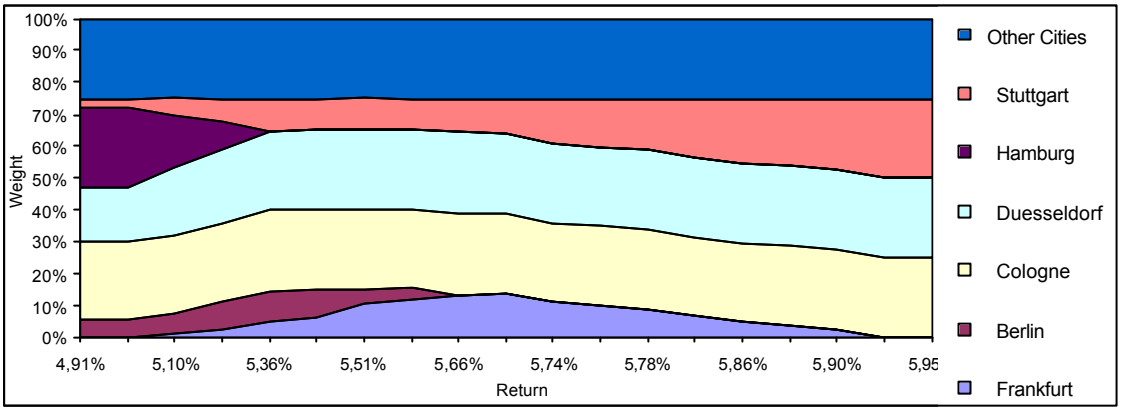


[21] Goetzmann / Wachter, Clustering methods, 1995, p. 271.

Optimal portfolio weights: weighting max. 100%



Optimal portfolio weights: weighting max. 25%



Sharpe Ratio-Maximum

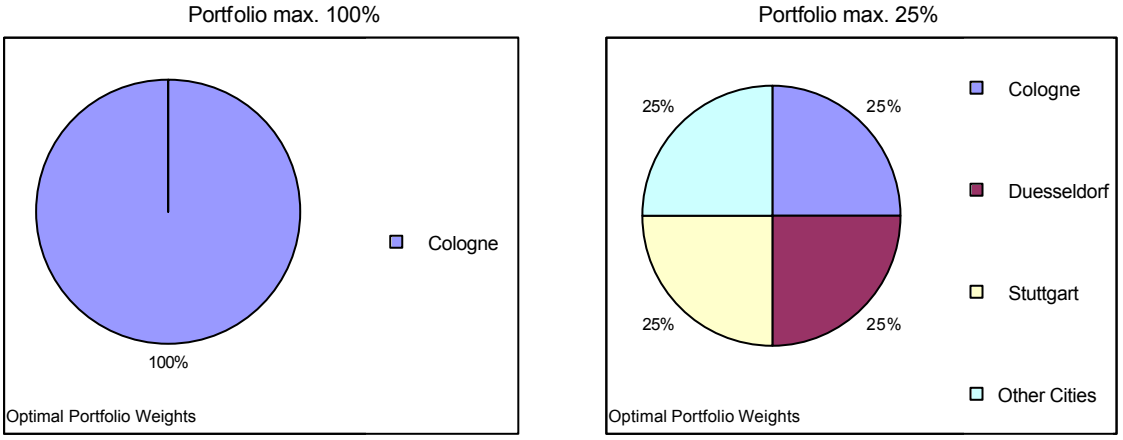


Figure 7: Efficient frontier and weightings of a portfolio with a combination of various German office markets[22]

Due to the present economic situation in Germany in combination with high vacancies and decreasing return expectations for the next quarters the most significant locations Frankfurt and Munich are not represented in an optimal portfolio. Both show in comparison to medium-sized cities such as Duesseldorf, Cologne and Stuttgart on average a lower return in combination with partly higher risks in the time period. An optimal portfolio, therefore, includes other cities and

22 Calculated on the basis of data provided by DID Deutsche Immobilien Datenbank GmbH, Wiesbaden 2003.

Cologne, yet again depending on the targeted risk-return-ratio relationship. The MRP consists a 100% of Cologne.

As expected the diversification across locations within Germany is less risk-reducing than a Europe-wide diversification. The German MVP and MRP each show low returns with a maximum of 6.75% with a low standard deviation. This result is confirmed by a SRM of 0.6 in comparison to 16.1.

In accordance with the rather pragmatic position of a weighting constraint of 25% the rational national investor would opt for an equal weighting of the locations Cologne, Duesseldorf, Stuttgart and other cities with a maximum return of 5.9% and a risk of 1.5%. Interestingly enough, the inclusion of the unfavourable Frankfurt and Berlin in portfolios according to their risk return structure (see Figure 7) has a risk reducing effect, which is due to their negative correlation to Stuttgart and Cologne.

It is, however, questionable, whether investors would actually invest in this sub-segment without the consideration of possible diversification objectives, because with a maximum return of less than 6% the returns are relatively low in comparison to the risk-free interest rates. A decision to invest can, consequently, only be justified with a risk diversification in relation to other asset classes.

III. Property Diversification

Property diversification may be differentiated according to the nature of properties. The most important characteristics are types of use, size or value of the property as well as age, depending on year of construction or remaining useful life of building.

a) Diversification across Sectors

The diversification according to sectors of use has as shown in various studies the highest diversification potentials.[23]

Present studies prove also for Germany the success of sectoral diversification. The empirical analysis on the basis of DIX data from 1996 to 2002 shows a correlation coefficient with an average correlation coefficient of 0.3, in spite of a relatively strong synchrony of some market sector returns (office and retail/office: 0.95). These were balanced by a multitude of negative correlations. High diversification potentials for office and industrial use can be concluded from negative correlations (-0.8).

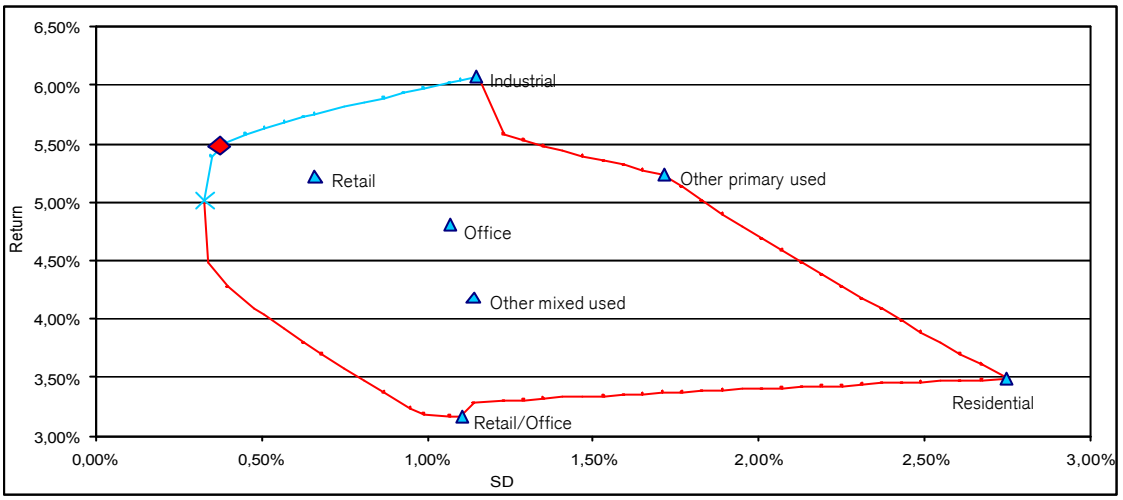
The results for individual returns and risks as well as risk-optimal and return-optimal combinations of portfolio weightings are shown in the following Figure 8. As the correlation coefficients already conclude the sectors industrial and office represent the main components of efficient portfolios. Due to its maximum average return of 6.1% the industrial use sector included to a 100% in the MRP. With an naive equal weighting a risk reduction in relation to the MRP can be achieved. The SRMP with a higher return as the equal weighting even achieves a reduction by 1.2-0.4=0.8 percentage points.

[23] Eichholtz, Invest Internationally, 1997, p. 53ff. and Fisher / Liang, Diversification, 2000, p. 37f.

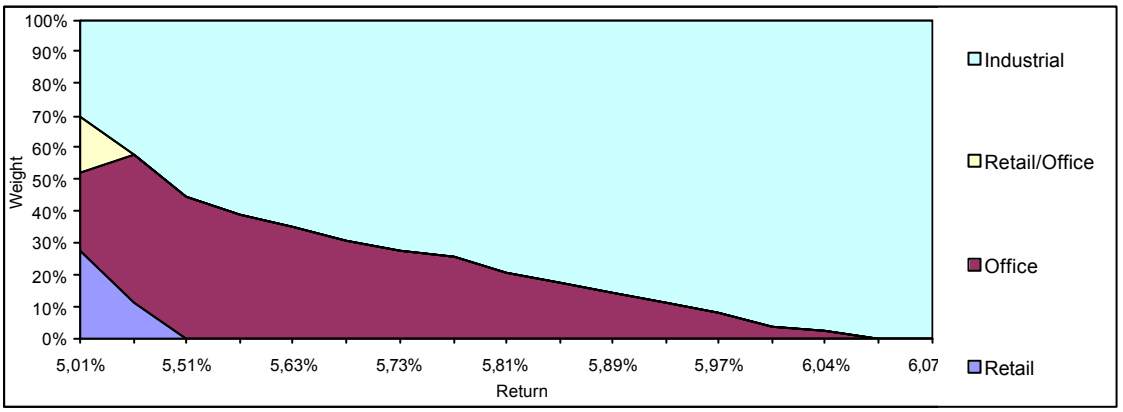
Results of the Portfolio 3: Property Type, Germany, Source: DID 2003

Results			Portfolio max. 100%	Risk min.	Return max.	Sharpe Ratio max.	Equal weighted	Portfolio max. 25%	Risk min.	Return max.	Sharpe Ratio max.
			Portfolio Mean	**5,01%**	**6,07%**	**5,48%**	**4,59%**	**Portfolio Mean**	**4,90%**	**5,33%**	**5,33%**
			Portfolio SD	**0,33%**	**1,15%**	**0,37%**	**0,81%**	**Portfolio SD**	**0,35%**	**0,64%**	**0,64%**
Assets	**Mean**	**SD**	**Sharpe Ratio**	**1,5455**	**1,3652**	**2,6486**	**0,1111**	**Sharpe Ratio**	**-2,0000**	**-0,4219**	**-0,4219**
				Weights					***Weights***		
Retail	5,22%	0,66%	Retail	27,32%	0,00%	0,00%	14,29%	Retail	25,00%	25,00%	25,00%
Office	4,81%	1,07%	Office	24,76%	0,00%	46,75%	14,29%	Office	25,00%	25,00%	25,00%
Retail/Office	3,16%	1,10%	Retail/Office	17,69%	0,00%	0,00%	14,29%	Retail/Office	20,86%	0,00%	0,00%
Industrial	6,07%	1,15%	Industrial	30,23%	100,00%	53,25%	14,29%	Industrial	25,00%	25,00%	25,00%
Residential	3,49%	2,75%	Residential	0,00%	0,00%	0,00%	14,29%	Residential	0,00%	0,00%	0,00%
Other mixed	4,18%	1,14%	Other mixed	0,00%	0,00%	0,00%	14,29%	Other mixed	0,00%	0,00%	0,00%
Other primary	5,24%	1,71%	Other primary	0,00%	0,00%	0,00%	14,29%	Other primary	4,14%	25,00%	25,00%
			Total	**100%**	**100%**	**100%**	**100%**	**Total**	**100%**	**100%**	**100%**

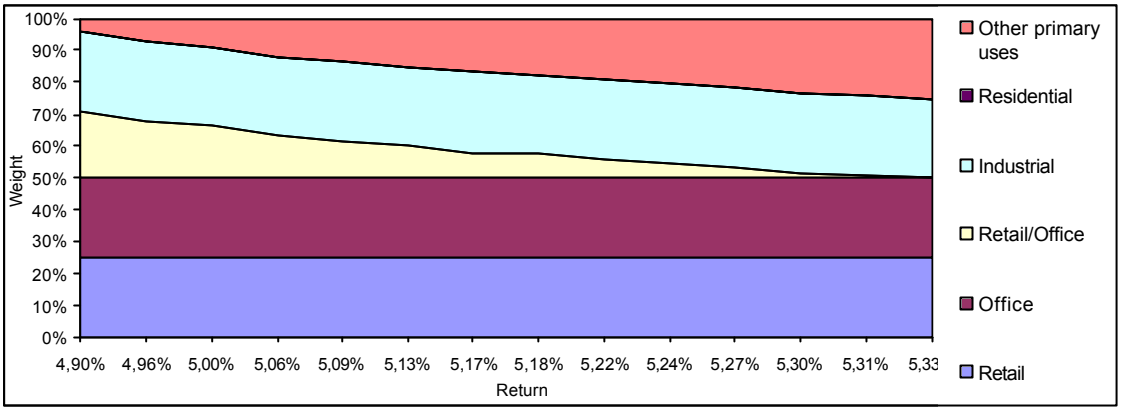
Efficient Frontier



Optimal portfolio weights: weighting max. 100%



Optimal portfolio weights: weighting max. 25%



Sharpe Ratio-Maximum

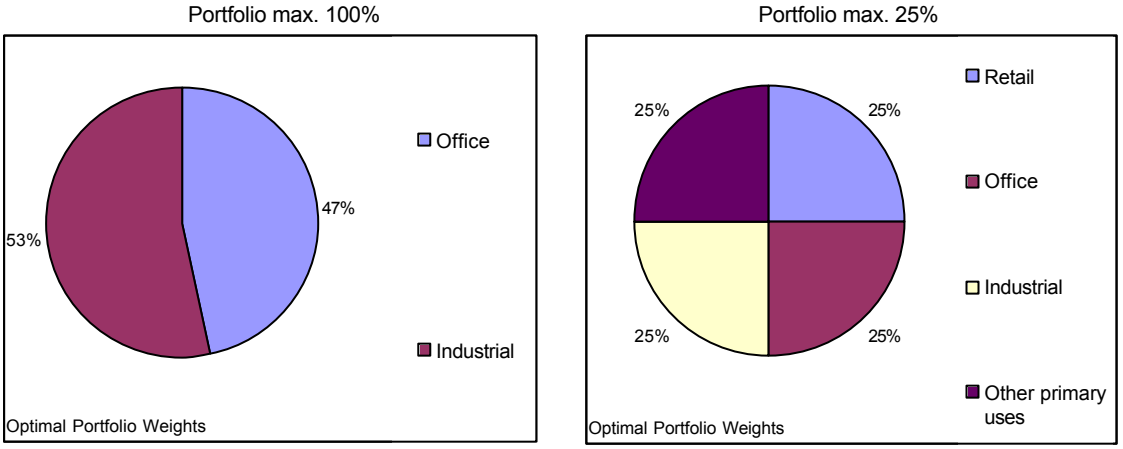


Figure 8: Efficient frontier and weightings of a portfolio with a combination of various German property sectors[24]

Also from the efficient frontier and its related portions a relatively good risk reduction potential can be deduced. While the return shows a span from 6.1-5.0=1.1 percentage points, the standard deviation can be reduced by 1.2-0.3=0.9 percentage points in the MVP.

In 25%-portfolios the types of use industrial, office, retail and other primary uses are the main components of efficient portfolios. In the areas with marginal returns mixed uses (retail/office) are included in the efficient return.

The Sharpe Ratios can not be evaluated for this study as the returns are mostly lower than the risk-free interest rates.

b) Diversification according to Size and Value

One possibility property diversification is across the size of the individual properties. The assumption is that smaller properties behave differently in the economic cycle than larger properties. As measurements total floors space or financial variables such as total income, market value or investment volume may be used.

[24] Calculated on the basis of data provided by DID Deutsche Immobilien Datenbank GmbH, Wiesbaden 2003.

Again this analysis was conducted on the basis of DIX data. The correlation table mainly shows positive diversification potential. Only when smaller properties with a value of € 2.5 Million are included negative relations can be observed.

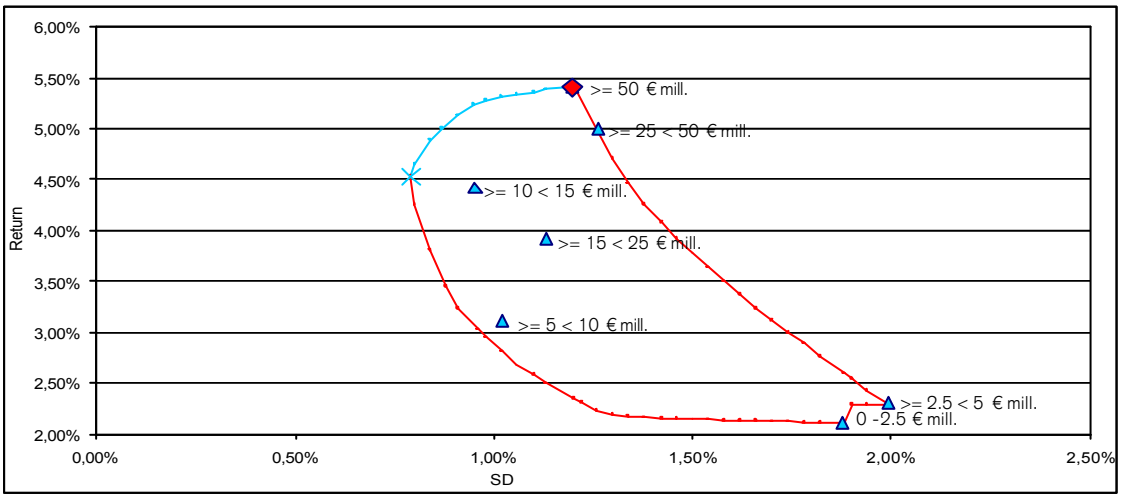
In Figure 9 all data for the evaluation of these portfolio combinations are shown. Again the data is based on the DIX data basis, consequently, the results are comparable with the analysis of figures 2 to 6.

Differences occur in the analysis of values for the MVP and the MRP. The diversification according to cities and types of use shows the most extreme return values, not necessarily with the highest standard deviations. As a result this form of diversification is to be seen as less significant than the two others.

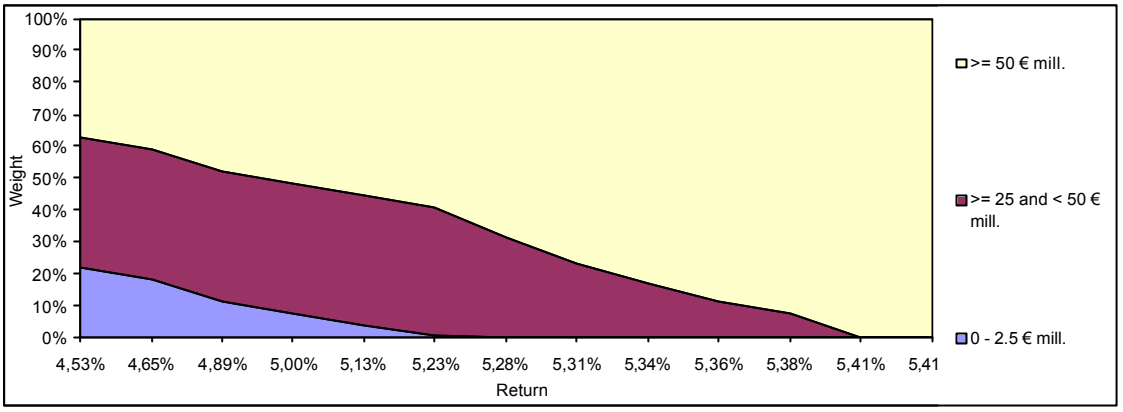
Results of the Portfolio 4: Property Value, Germany, Source: DID 2003

Results			Portfolio max. 100%	Risk min.	Return max.	Sharpe Ratio max.	Equal weighted	Portfolio max. 25%	Risk min.	Return max.	Sharpe Ratio max.
			Portfolio Mean	**4,53%**	**5,41%**	**5,41%**	**3,76%**	**Portfolio Mean**	**4,36%**	**4,69%**	**4,69%**
			Portfolio SD	**0,79%**	**1,20%**	**1,20%**	**0,96%**	**Portfolio SD**	**0,83%**	**0,93%**	**0,93%**
Assets	**Mean**	**SD**	**Sharpe Ratio**	**-1,3544**	**-0,1583**	**-0,1583**	**-1,9167**	**Sharpe Ratio**	**-1,4940**	**-0,9785**	**-0,9785**
				Weights					***Weights***		
0 - 2.5 € mill.	2,12%	1,88%	0 - 2.5 € mill.	21,49%	0,00%	0,00%	14,29%	0 - 2.5 € mill.	18,20%	0,00%	0,00%
>= 2.5 < 5 € mill.	2,30%	1,99%	>= 2.5 < 5 € mill.	0,00%	0,00%	0,00%	14,29%	>= 2.5 < 5 € mill.	0,00%	0,00%	0,00%
>= 5 < 10 € mill.	3,12%	1,02%	>= 5 < 10 € mill.	0,00%	0,00%	0,00%	14,29%	>= 5 < 10 € mill.	0,00%	0,00%	0,00%
>= 10 < 15 € mill.	4,42%	0,95%	>= 10 < 15 € mill.	0,00%	0,00%	0,00%	14,29%	>= 10 < 15 € mill.	25,00%	25,00%	25,00%
>= 15 < 25 € mill.	3,92%	1,13%	>= 15 < 25 € mill.	0,00%	0,00%	0,00%	14,29%	>= 15 < 25 € mill.	6,80%	25,00%	25,00%
>= 25 < 50 € mill.	5,00%	1,26%	>= 25 < 50 € mill.	41,49%	0,00%	0,00%	14,29%	>= 25 < 50 € mill.	25,00%	25,00%	25,00%
>= 50 € mill.	5,41%	1,20%	>= 50 € mill.	37,02%	100,00%	100,00%	14,29%	>= 50 € mill.	25,00%	25,00%	25,00%
			Total	**100%**	**100%**	**100%**	**100%**	**Total**	**100%**	**100%**	**100%**

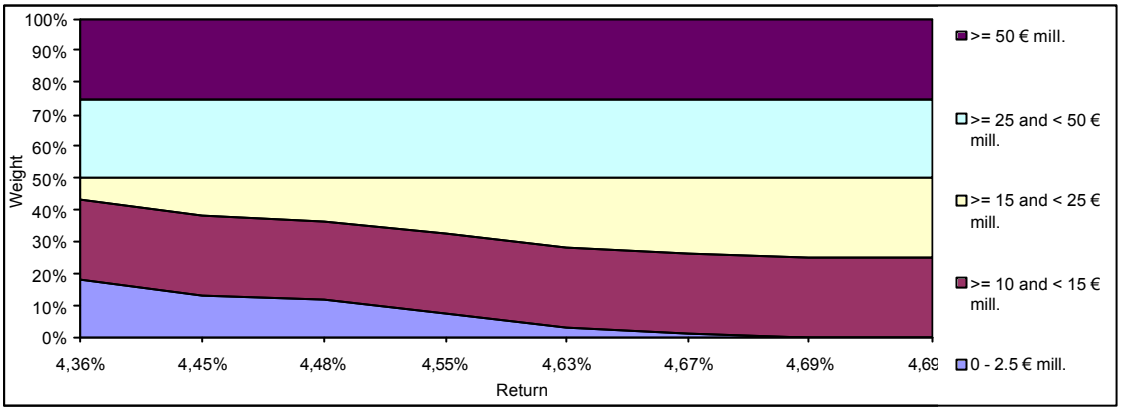
Efficient Frontier



Optimal portfolio weights: weighting max. 100%

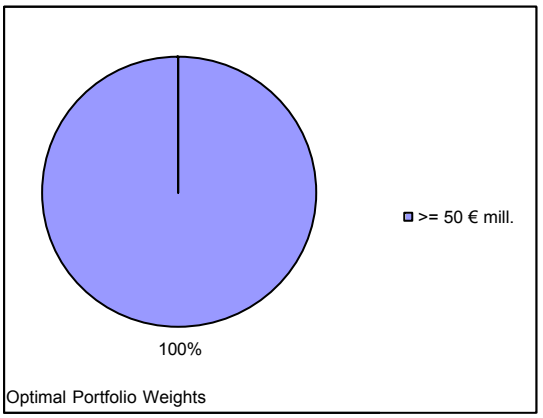


Optimal portfolio weights: weighting max. 25%



Sharpe Ratio-Maximum

Portfolio max. 100%



Portfolio max. 25%

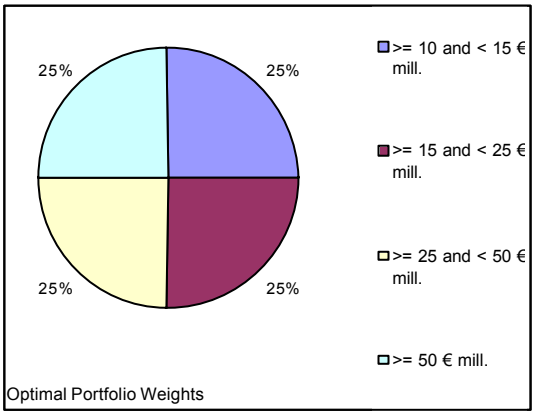


Figure 9: Efficient frontier and weightings of a portfolio with a combination of various German property values[25]

Within the process of optimisation of portfolios according to market values on the basis of the data analysed, only three categories can be found in efficient portfolios i.e. either particularly properties with low values or properties with values from € 25 to 50 Million and above (see Figure 9).

25 Calculated on the basis of data provided by DID Deutsche Immobilien Datenbank GmbH, Wiesbaden 2003.

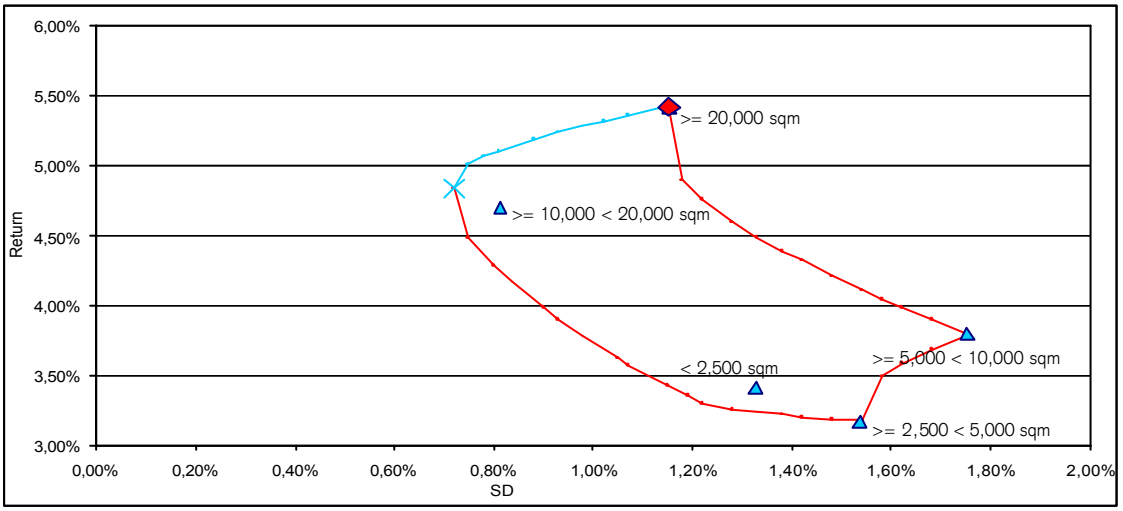
Again the returns with a maximum of 5.4% are unattractive in contrast to other investment opportunities and only diversification effects in relation to other asset classes would justify this investment alternative.

The analysis according to size was conducted on the basis of floor space. Also these portfolios provide low diversification opportunities in comparison to the analysis 2 and 3. The efficient portfolios and their weightings shown in Figure 10 confirms the results of the analysis on diversifications across market values. Here the optimal portfolios consist of smaller properties (up to 5,000 sqm) as well as of larger properties (from 10.000 sqm and above).

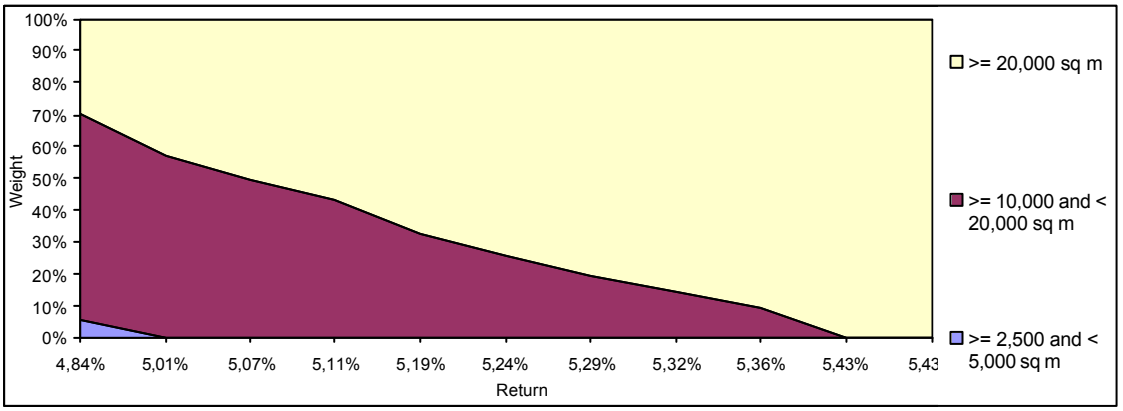
Results of the Portfolio 5: Property Space, Germany, Source: DID 2003

Results			Portfolio max. **100%**	Risk min.	Return max.	Sharpe Ratio max.	Equal weighted	Portfolio max. **25%**	Risk min.	Return max.	Sharpe Ratio max.
			Portfolio Mean	**4,84%**	**5,43%**	**5,43%**	**4,10%**	**Portfolio Mean**	**4,18%**	**4,34%**	**4,34%**
			Portfolio SD	**0,72%**	**1,15%**	**1,15%**	**1,05%**	**Portfolio SD**	**0,91%**	**1,05%**	**1,05%**
Assets	**Mean**	**SD**	**Sharpe Ratio**	**-1,0556**	**-0,1478**	**-0,1478**	**-1,4286**	**Sharpe Ratio**	**-1,5604**	**-1,2000**	**-1,2000**
				Weights					***Weights***		
< 2,500 sqm	3,42%	1,33%	< 2,500 sqm	0,00%	0,00%	0,00%	20,00%	< 2,500 sqm	25,00%	25,00%	25,00%
>= 2,500 < 5,000 sqm	3,18%	1,54%	>= 2,500 < 5,000 sqm	5,18%	0,00%	0,00%	20,00%	>= 2,500 < 5,000 sqm	25,00%	0,00%	0,00%
>= 5,000 < 10,000 sqm	3,80%	1,75%	>= 5,000 < 10,000 sqm	0,00%	0,00%	0,00%	20,00%	>= 5,000 < 10,000 sqm	0,00%	25,00%	25,00%
>= 10,000 < 20,000 sqm	4,70%	0,81%	>= 10,000 < 20,000 sqm	65,17%	0,00%	0,00%	20,00%	>= 10,000 < 20,000 sqm	25,00%	25,00%	25,00%
>= 20,000 sqm	5,43%	1,15%	>= 20,000 sqm	29,65%	100,00%	100,00%	20,00%	>= 20,000 sqm	25,00%	25,00%	25,00%
			Total	**100%**	**100%**	**100%**	**100%**	**Total**	**100%**	**100%**	**100%**

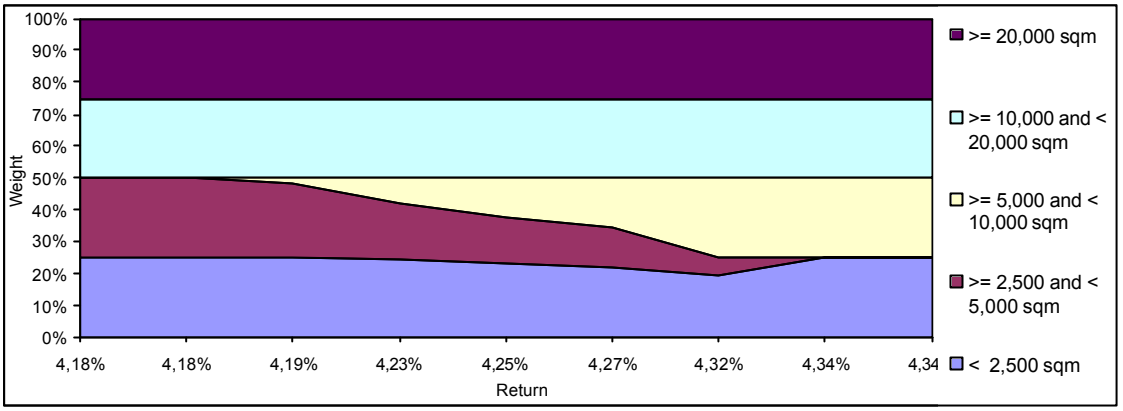
Efficient Frontier



Optimal portfolio weights: weighting max. 100%



Optimal portfolio weights: weighting max. 25%



Sharpe Ratio-Maximum

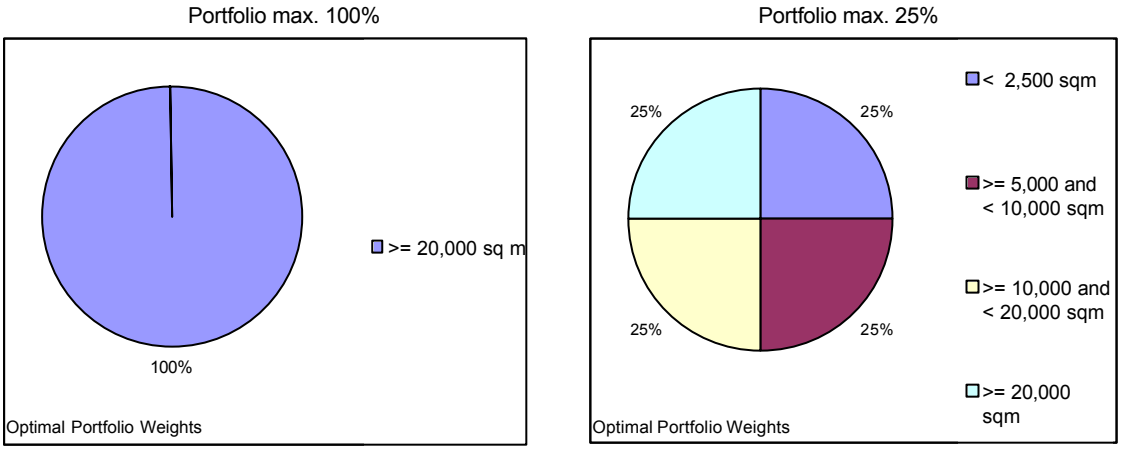


Figure 10: Efficient frontier and weightings of a portfolio with a combination of various German property sizes by sqm floor space[26]

Due to their negative values the Sharpe Ratios can not be determined for both diversification calculations according to size.

c) Diversification across Building Age

A further possibility of diversification across property characteristics is the mix of buildings with different ages.[27] The reason for diversifications effects according to building ages is the mix of different age classes in connection with the time of construction including architectural style and type of construction. An architectural monument, for example, can influence the image of the property positively and with that, also, effect the lettability positively. Another characteristic connected with age is the standard of the building. Apart from top-refurbished objects the level of standard correlates positively with the increasing date of construction of the building. Also here a diversification of standing investments can be reasonable, as a higher standard of the building also means higher rents. Consequently a link exists to the diversification according to value of the property.

26 Calculated on the basis of data provided by DID Deutsche Immobilien Datenbank GmbH, Wiesbaden 2003.

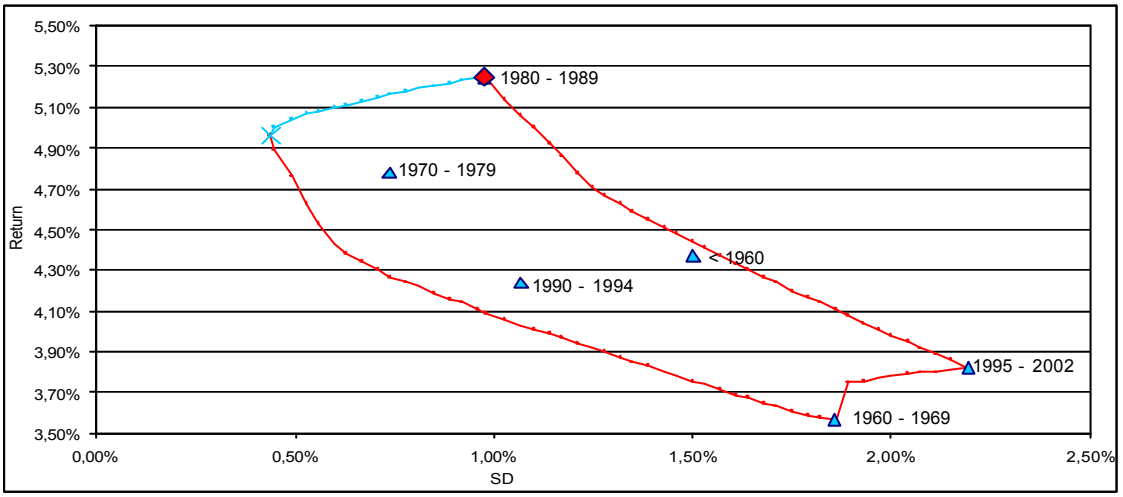
27 Del Casino, Portfolio Diversification Considerations, 1995, p. 920f.

The results of this analysis, however, show yet again low diversification potentials. The efficient frontier has a narrow span of only 5.0; 0.4 in the MVP as well as 5.2 and 1.0 in the MRP. A return of 5.2% is unattractive in comparison to the other portfolios considered. It is to be noted that efficient portfolios consist of properties of medium age, as properties from the years 1970 to 1989 achieve the highest returns in connection with the lowest risks in comparison to other years of construction (see Figure 11).

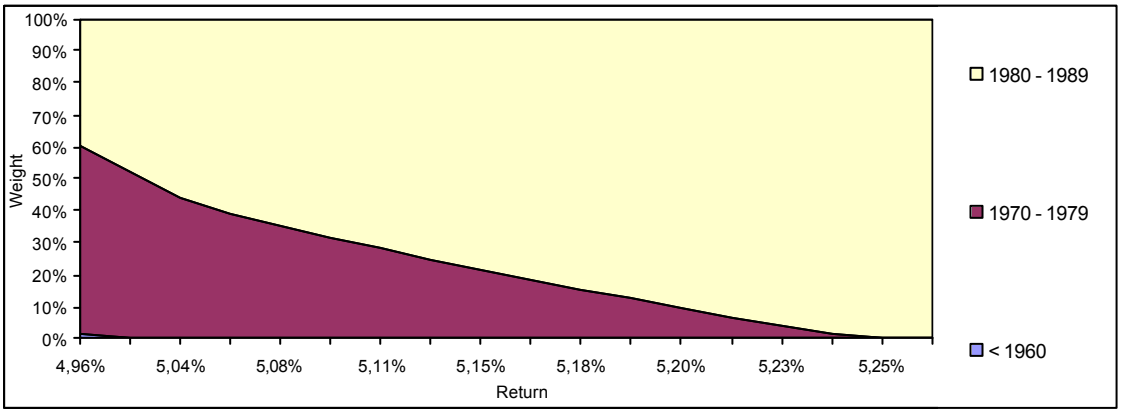
Results of the Portfolio 6: Property Age, Germany, Source: DID 2003

Results			Portfolio max. 100%	Risk min.	Return max.	Sharpe Ratio max.	Equal weighted	Portfolio max. 25%	Risk min.	Return max.	Sharpe Ratio max.
			Portfolio Mean	**4,96%**	**5,25%**	**5,25%**	**4,34%**	**Portfolio Mean**	**4,66%**	**4,66%**	**4,66%**
			Portfolio SD	**0,44%**	**0,98%**	**0,98%**	**1,04%**	**Portfolio SD**	**0,72%**	**0,72%**	**0,72%**
Assets	**Mean**	**SD**	**Sharpe Ratio**	**-1,4545**	**-0,3571**	**-0,3571**	**-1,2115**	**Sharpe Ratio**	**-1,3177**	**-1,3135**	**-1,3177**
				Weights					***Weights***		
< 1960	4,37%	1,50%	< 1960	1,70%	0,00%	0,00%	16,67%	< 1960	24,64%	25,00%	24,64%
1960 - 1969	3,57%	1,86%	1960 - 1969	0,00%	0,00%	0,00%	16,67%	1960 - 1969	0,36%	0,00%	0,36%
1970 - 1979	4,78%	0,74%	1970 - 1979	58,76%	0,00%	0,00%	16,67%	1970 - 1979	25,00%	25,00%	25,00%
1980 - 1989	5,25%	0,98%	1980 - 1989	39,54%	100,00%	100,00%	16,67%	1980 - 1989	25,00%	25,00%	25,00%
1990 - 1994	4,24%	1,07%	1990 - 1994	0,00%	0,00%	0,00%	16,67%	1990 - 1994	25,00%	25,00%	25,00%
1995 - 2002	3,82%	2,19%	1995 - 2002	0,00%	0,00%	0,00%	16,67%	1995 - 2002	0,00%	0,00%	0,00%
			Total	**100%**	**100%**	**100%**	**100%**	**Total**	**100%**	**100%**	**100%**

Efficient Frontier



Optimal portfolio weights: weighting max. 100%



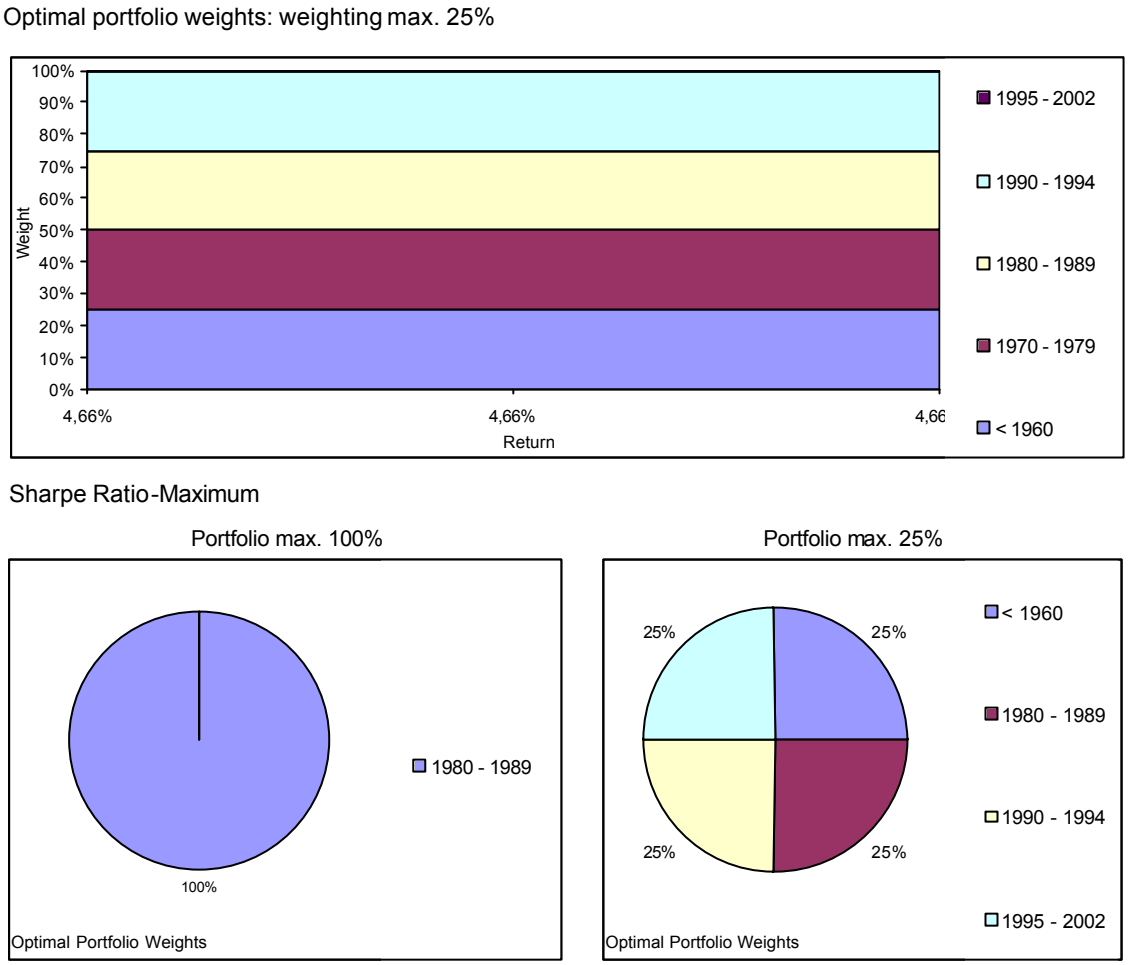


Figure 11: Efficient frontier and weightings of a portfolio with a combination of various German building ages[28]

IV. Summary of Empirical Results

A conclusive assessment of the data concerning the MVP, the MRP and the SRM is shown for all analysis in Figure 12. The Sharpe Ratio represents the indicator for the individual portfolios, where higher Sharpe Ratios stand for a better risk-adjusted return of the portfolio in comparison to the benchmark.[29]

The analysis of Figure 12 in combination with the corresponding efficient frontiers of all empirical surveys in Figure 13 leads to the following conclusions:

- The highest returns were achieved through an investment in European markets represented through the various national indices from 1998 to 2002, which were, however, connected with a higher risk.
- The lowest risk was by investing in German properties and diversifying across sectors between 1996 to 2002 in the MVP.
- The most risk efficient portfolios were also achievable through investments in European national indexes via the SRM portfolio, derived from the highest Sharpe Ratio of 16.1.

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28 Calculated on the basis of data provided by DID Deutsche Immobilien Datenbank GmbH, Wiesbaden 2003.

29 Bruns, Meyer-Bullerdiek, Professionelles Portfoliomanagement, 2003, p. 518f.

Example Portfolio	Data basis (Source, Time)	Portfolio data	MVP	MRP	SRM
1 Countries (Europe)	IPD Indices, Total Returns, 1998-2002	Mean SD SR	8,07 0,34 10,50	**18,95** 13,12 1,10	11,60 0,44 **16,14**
2 Cities in Germany (Office)	DIX, Total Returns, 1996-2002	Mean SD SR	5,14 0,52 -	6,75 1,91 0,60	6,75 1,91 0,60
3 Germany - Sectors	DIX, Total Returns, 1996-2002	Mean SD SR	5,01 **0,33** 1,55	6,07 1,15 1,36	5,48 0,37 2,65
4 Germany – Property Value	DIX, Total Returns, 1996-2002	Mean SD SR	4,53 0,79 -	5,41 1,20 -	- - -
5 Germany – Floor Space	DIX, Total Returns, 1996-2002	Mean SD SR	4,84 0,72 -	5,43 1,15 -	- - -
6 Germany – Building Age	DIX, Total Returns, 1996-2002	Mean SD SR	4,96 0,44 -	5,25 0,98 -	- - -

Figure 12: Comparison of all results (Extreme figures in bold print) [30]

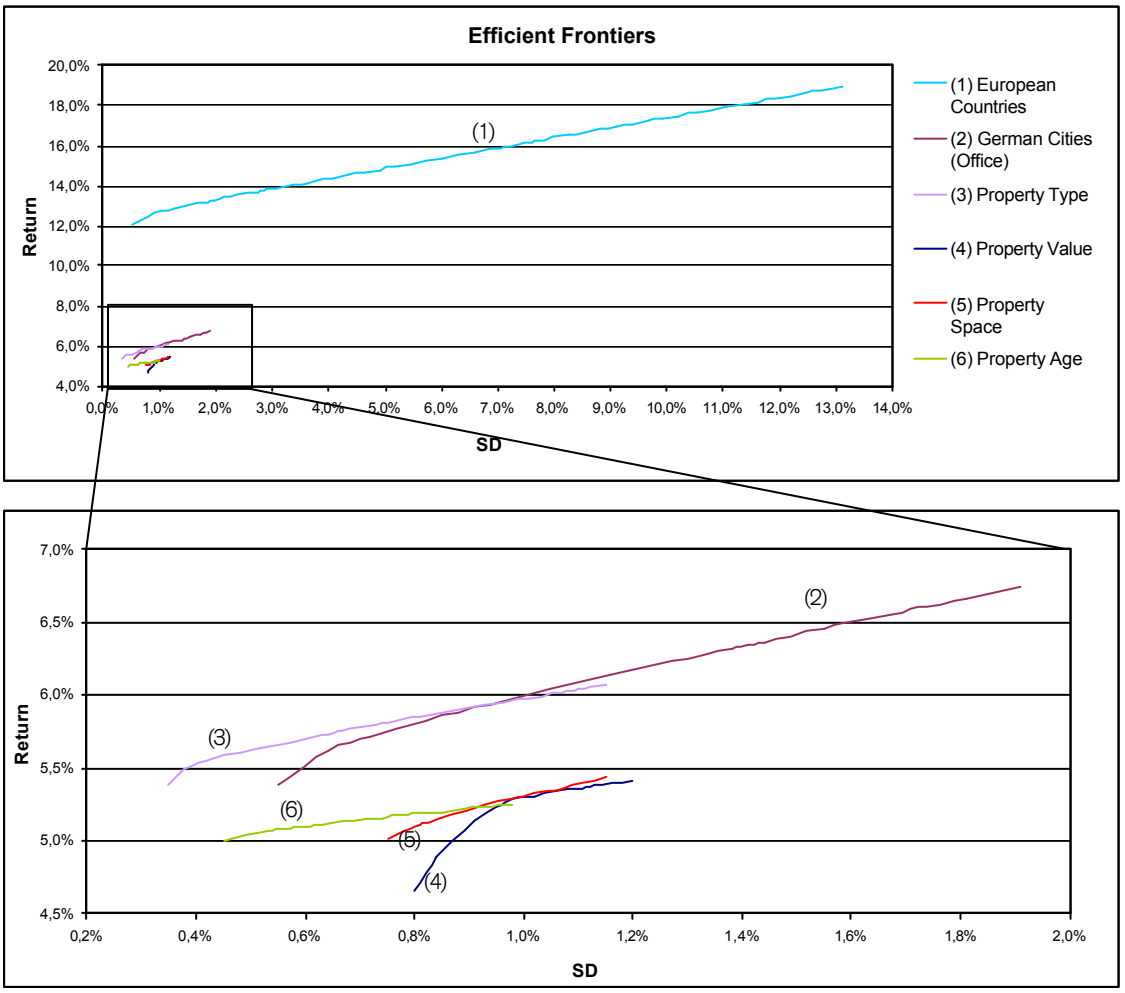

Figure 13: Efficient frontiers of all empirical surveys

[30] Negative Sharpe Ratios have been omitted.

- The lowest diversification effects were to be found in a diversification across value, as here with 0.41 percentage points the lowest risk reduction was achieved in conjunction with the lowest returns in the MVP and MRP.
- For risk-hungry investors a mix of European locations is to be recommended (Sharpe Ratio 1.1 to 16.1). Risk-averse investors should diversify in German properties according to sectors (maximum risk 1.15% with a return of still 6.1%).
- The portfolios 1 and 3 are better performing also after a visual assessment of their efficient frontiers in comparison to other efficient frontiers. They are either more profitable – as they can be found at the top, or low-risk, as the can be found on the left-hand side (see Figure 13).

In principal the international diversification across different nations can thus be classified as most successful, as the development of returns is mainly determined by national or regional factors. The development of sub-markets is closely linked to governmental conditions. For the EURO Zone a change of these connections is likely in the future. The harmonization of economic developments also affects the property markets. A diversification across different regions and cities becomes in comparison to an international diversification more significant for the diversification of portfolios. The parallel development of returns in recent years shown in the statistical series of the different empirical studies, also confirm this trend.

A spreading of investments is only helpful when the types of diversification are combined with each other, i.e. are step by step across the different types. Following the outlined procedure it is most likely, that the diversification effects increase significantly, when a diversification across European countries and of a diversification across sectors within those countries is combined.

Therefore a phased approach which takes the individual diversification possibilities into account following is to be recommended. Before individual portfolio components are selected, firstly the individual investment target must be determined on the basis of appropriate indicators (risk / return). Based on the determined risk approach the theoretical steps of a quantitative diversification model following a top-down approach are as follows.[31]

1. Analysis of the relevant markets (see Figure 4),
2. Selection of profitable markets according to locations (countries, regions, cities and districts),
3. Selection of profitable markets according to sectors and property characteristics,
4. Combination of locations, sectors and property characteristics,
5. Selection of the portfolio weighting of the pre-selected market on the basis of the determined optimal portfolios via portfolio selection
6. Analysis of prospective properties and selection of appropriate properties in the pre-selected markets according to the calculated optimal weightings,
7. Timing decisions including entry-level and exit points (on the basis of time and value limits),
8. Calculation of performance of the combined portfolios as benchmark and
9. Possible portfolio adaptation via a renewed processing of the individual steps.

D. Summary

It has been shown, that a diversification across locations especially across different countries produces the strongest effects, closely followed by the diversification across sectors. The

[31] Ori, Portfolio diversification strategy, 1995, S. 29.

diversification according to property characteristics shows the weakest effects which could be explained with the connection between types of use and locations. Consequently, a locational diversification on international level is to be preferred to a sectoral diversification, without neglecting this possibility.

This paper investigated whether the application of the *Portfolio Selection Theory* is also reasonable for European and German property investments. This was confirmed in principle by the results of the individual studies. In spite of the short data basis the empirical studies showed that it is possible to eliminate to a varying extent the unsystematic property-specific risk through a diversification across different characteristics. This was possible even though the data extracted from the market indexes already included a diversification due to the random market mix of the index composition. The diversification effects would accordingly be significantly higher, when the property data of actual portfolios were used. Consequently, it can not be fully estimated, how the portfolio composition of ex post optimal portfolios behaves in real developments in the immediate future, also because the determined risk and return parameters are not fully deducted from normally distributed returns.[32]

Here it should be referred again to the difficulty of reconstructing optimal model portfolios including the accompanying problems concerning the implementation of theory into practice. Optimal locations from a portfolio theoretical perspective can possess besides lacking market size (as for example markets like the smaller Benelux countries and Ireland) also barriers to entry e.g. information asymmetry between foreigners and native citizens or insufficient security of legal right of property. Equally theoretically inefficient markets according to risk return considerations, may be attractive to market participants, because the transactions costs for those participants may be low due to their good market knowledge. A further problem is finding of the optimal property with the exactly the right size according to the market mean. Individual properties can certainly perform better than the market portfolio and show an out-performance, which further complicates a theoretical portfolio analysis.

Here it must be noted that the benefits of the diversification must be in proportion to the cost for the data collection and the necessary transactions costs for the implementation. The costs must not exceed the return increase (with stable risk) gained through the portfolio shifting.[33] A limited diversification strategy can produce lower implementation costs in comparison to a strongly diversifying portfolio strategy.[34] It should not be forgotten that the application of the MPT always includes the regular violation of its assumptions, hence its results are only of limited significance.

The main problem with the application of the MPT in Europe and Germany are the lacking data basis in connection with an insufficient data quality and less the assumptions behind the Markowitz portfolio model The quality of the output, though, can only be as good as the quality of the data input.[35]

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32 See Pagliari / Webb / Del Casino, Applying MPT, 1995, p. 74 for analysing the behaviour of ex ante and ex post optimal portfolios.

33 Bruns / Meyer-Bullerdiek, Professionelles Portfolio-Management, 2003, p. 75 and Lizieri / Finlay, International property portfolio strategies, 1995, p. 8f.

34 Eichholtz et al., Portfolio diversification, 1995, p. 40.

35 Bruns / Meyer-Bullerdiek, Professionelles Portfolio-Management, 2000, p. 74f.

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