Universität Zürich

Masterthesis

To achieve the the title of

Master of Advanced Studies in Real Estate

Correlations between direct and indirect real estate investments in Switzerland;

A macro and micro empirical analysis of real estate as an asset class

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1 Executive Summary

Subject of examination in this thesis is the relationship between direct and indirect investments in swiss real estate. Classical economists tend to argue that there can be no difference in value because of the invisible hand of the market which adjusts the price to the always correct value. As we empirically observe, there are agios on listed real estate funds, so we must conclude that prices are not always in equilibrium. Some "gap" or lag between the values of the appraiser and the values the market determines through supply and demand, exist. By comparing returns and searching for explanations, we analyzed different correlations of index combinations. To be able to compare same with same, adjustments of de- leverage on listed funds and un-smoothing of direct investments are made due to the normal leverage of listed vehicles and bias of past transaction data of appraisers on direct real estate. On index level, we observed a strong relation of the unsmoothed direct index with the indirect index. The un- smoothing of the direct index strongly improves correlation, whereas unleveraging does not. While these results stand for the robust correlation, which removes the 10% most extreme points, the plain Pearson Correlation Coefficient does not give clear indications. This could partly be explained by the rather short time series of seven years observed, and partly due to the indirect index used because of its small exposure to foreign real estate which has totally different return patterns.

Due to the bias effect and the only yearly appraisals, it is specially to mention that the direct investment returns are very stable and tend to follow their indirect indices with a lag. In our examined swiss market, this lag is one period, which means one year. This "reaction time" can be professionally used to make superior returns compared to just investing in either direct or indirect real estate. These indirect market indications nevertheless can't be used directly, as there are several problems of implementation of such a strategy. These problems are the illiquid direct real estate market, which prevents from buying property fast, and the certainty of the indications the indirect market provides.

CONTENTS

2 Illustrations

3 Introduction

Real Estate Economics was not a subject of research for a long time in economic sciences. It was born out of a need in practice of how to operate and manage real estate, which brought this subject to specific academic analysis and examination. Initially as a sub- area within the asset-class of the Alternative Investments, then as an asset- class of it's own, it paid tribute to the raising demand of investors to invest in real estate. For building up an expertise about this specific topic, real estate has to be viewed in context with other asset classes as well as analyzed for it's unique criteria and characteristics. Performance- and risk measurement is mandatory for comparison with other asset classes[1].

In this thesis, we will first look at real estate at a macro level by comparing its performance of direct and indirect investment indices[2] with other asset classes before we dig deeper into real estate by comparing different funds in various market cycles.

4 Theoretical foundation

4.1 Behavioral finance in Real Estate

The last worldwide financial crises beginning 2007 due to the burst of the US housing market bubble followed the tech bubble in 2001 and the real estate bubble in Switzerland of the early 90's.

These events once again proved that even the classical economists had to admit that markets could be out of equilibrium and this for longer than a neglectable amount of time. Classical economy could not explain the over- and underreaction of the financial markets in such extreme moments of exuberance by rational behavior anymore. Because demand didn't pick up even with these now very low interest rates, governments worldwide reacted and applied a longtime forgotten theory of not only easing monetary supply but most importantly of increasing demand

[1] Sing (2004), p. 190
[2] Ireland (2008), p. 3

by fiscal theory developed by John Maynard Keynes. The classical economic theory of efficient and strictly rational markets which price in the appropriate amount of future value at all time is not sustainable. Keynes does not only incorporate in his theories the stimulus effect of government spending leading out of the investment trap, but also incorporates consumer behavior such as money illusion, biasedness, herding and sticky price effects[3]. The theories of old Keynes were picked up by the nobel price winners of 2001 Akerlof , Spence and Stiglitz, which nourished the before mostly mechanical economic theory with insights of human behavior of the decision making process from psychologists Kahnemann and Tversky [4]. The economic theory as a social science is getting more weight as such inputs are urgently needed to explain the "irrational" behavior of the individuals.

4.2 Swiss real estate market

The swiss real estate market is an internationally unique market because of its topography, strict zoning laws and buying restrictions of non-residential habitants.

Swiss law prohibits non- residential foreigners to invest in swiss residential properties due to "Lex Koller", a regulation aimed to protect the swiss properties from foreign control[5].

We will basically focus on the swiss real estate market because first, there is no thorough empirical analysis of real estate markets in Switzerland, and second because of the practical possible outcomes, which can be applied in investment strategies. Its outcome could be of value to investment advisors, fund managers, valuation companies and also index providers.

[3] Akerlof/Shiller, p. 5
[4] Kahnemann/Tversky, p. 7
[5] Schweizerische Eidgenossenschaft (2010)

4.3 Forms of direct and indirect investments

In this analysis, investment in Real Estate (RE) through different investment vehicles is of special interest[6]. First, we look at index level by comparing direct RE to indirect RE, then we compare two real estate investment funds.

Theoretically, based on the assumption of the same legal restriction, the same marginal tax rate and all other factors constant (ceteris paribus), it should make no difference weather to invest in direct Real Estate or through a fund or another vehicle[7].

There are various possible forms of investments in real estate, ranging from equity to debt to mezzanine exposures. Illustration 1 on the table below best achieves a classification[8]:

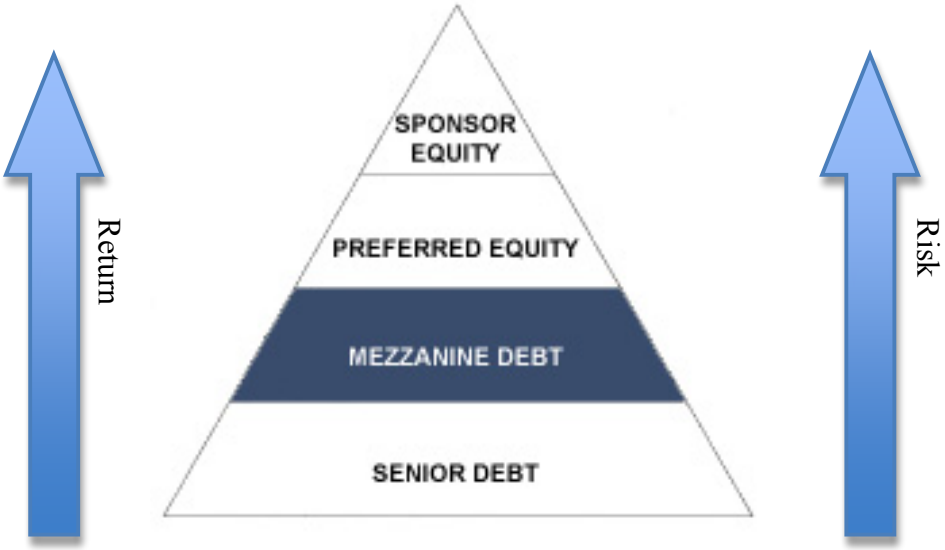


Illustration 1[9] : Forms of investment in real estate

[6] Ireland (2009), p. 3
[7] Sing Tien Foo (2004), p. 190
[8] Geltner, Miller (2007), p. 502
[9] Remington Financial (2010)

4.3.1 Indirect Equity

Shares of listed real estate companies can be bought at the stock exchange. Full equity exposure is more volatile than debt or mezzanine and therefore normally offers the highest return compensating for the risk being taken.[10]

4.3.2 Indirect Debt

Public traded debt of real estate companies can be bought on the market in form of government or corporate bonds. Indirect debt offers reduced exposure to real estate prices due to higher seniority than equity.

4.3.3 Direct Equity

Real estate can be purchased by directly buying a house. A negative point is the accumulation of risk due to poor diversification compared to a well diversified Real Estate Portfolio where huge amounts of assets are invested. Positive is the lower volatility compared with other investments. Private Equity also belongs to direct Equity.

4.3.4 Direct Debt

Loans given to buy direct real estate are treated as direct debt. Mostly issued by financial institutions, diversification is low and good market knowledge of the financial institutions giving out loans is necessary. A solution of the poor market liquidity is its sale to a MBS (mortgage backed securities) which allows the lender to have them off their balance sheet and not having to underlie it with more equity. MBS offer an indirect individualized investment opportunity by offering tranches of bonds with different seniority.

[10] Brealey, Myers (2000), p. 195

4.3.5 Mezzanine financing

Mezzanine financing is in its risk- return profile between equity and debt financing. An example is a convertible bond.[11]

4.3.6 Private Equity

Private capital is typically granted in the foundation or expansion phase of the business cycle. It is riskier than normal equity and therefore a higher yield is required[12].

4.4 Asset Valuation in Real Estate

Valuation in real estate markets uses different methods ranging from the simple cost approach to more sophisticated approaches known from finance as risk- adjusted cash flow analysis.[13]

4.4.1 Cost approach

The value of the property is calculated as the sum of the costs occurred of purchasing the construction site and building the property. The overall costs define the value of the property.[14]

[11] Geltner, Miller (2007), p. 503
[12] Geltner, Miller (2007), p. 571
[13] Geltner, Miller, p. 202
[14] Geltner, Miller, p. 202

4.4.2 Peer Analysis

The value of the property is calculated on the basis and in comparison with other properties on the market. The properties are compared and adjusted for different characteristics.[15]

4.4.3 Revenue measurement

The gross revenue of a real estate project will be calculated by dividing the net revenue from rental income by the appropriate discount rate. The discount rate has a huge influence on property values and must therefore be carefully chosen.[16]

4.4.4 Cash flow analysis

The value determination with cash flow is the most complex method, as it is forward looking and requires several high quality input factors. The outcome is very dependent of the discount rate, and of the timeframe for which the revenue and costs incur. Additionally, the cash flow must be properly adjusted for rental expenses such as energy costs, cleaning costs and other property affiliated costs, which the renter agreed to pay to get out the exact gross rental yield of the property. In the next step, all the costs not being able to charge the renter will have to be deducted from cash flow such as administration or renovation costs.[17] The tax shield of highly leveraged real estate also must be considered in an exact Net Present Value Analysis (NPV Analysis). Please note that the NPV and IRR can sometimes lead to contradictory values, as there is more than one IRR mathematically possible[18]. This is due to the possible cash flow structure when the sign changes more than once[19].

[15] IAZI (2010)
[16] Geltner, Miller, p. 202
[17] Geltner, Miller, p. 203
[18] Geltner, Miller (2007), p. 206
[19] Brealey, Myers (2000), p. 103

5 Methodology

5.1 General Procedure

Exchange traded companies or listed investment funds generally operate with leverage and direct property values are based on periodic appraisals, which are often done in large intervals and are highly influenced by earlier appraisals.

To make data of the macro index level and micro fund level comparable, they have to be based on the same assumptions for being able to generate suitable conclusions. The values of the underlying real estate have to be cleared out of these effects.

5.2 Deleveraging

When using leverage, return on investment (ROI) differs from return on equity (ROE). For comparison of the revenues, leverage must be considered to compare it with the return of the unlevered direct investments. This is done with the following calculation:

We start with the simple quotation of the weighted average cost of capital (WACC)[20]:

$r_p = (LTV)r_d+(1-LTV)r_E$

where r_p is the return on the underlying property, r_d is the return on debt, r_e is the return on the levered equity in the property and LTV is the loan to value ratio.

We solve for r_e, this leads us to[21]:

$R_e=(r_p-LTVr_d)/(1-LTV)$ (ROE on the levered investment)

[20] Geltner, Miller (2007), p. 308
[21] Geltner, Miller (2007), p. 309

With this equation, the levered return on equity of indirect leveraged investment is calculated. This is the return investors will achieve when they invest indirect in funds or real estate companies where leverage is used.

But to be able to compare indirect investments with direct ones, leverage must be eliminated. This is done with the following formula[22]:

$R_p = (R_e – LTE * R_d)/ (1 + LTE)$ (ROI of a unlevered investment)

Where:

R_p = Return of property (comparable return)

R_e = Return on equity (levered return)

LTE = Loan to Equity ratio

t = marginal tax rate

5.2.1 Tax

Tax is clearly an issue in our calculations concerning the de- leverage of indirect investment indices. In most legislation as well as in Switzerland, interest rates such as on corporate debt or on mortgage debt can be deducted from taxable income. This tax advantage of debt is commonly referred to as the "tax shield" of debt financing which must be taken into account when valuing investment opportunities.

Therefore, we corrected our formula for deleveraging the return on investment to calculate the unlevered return net of tax (including tax shield[23]) to:

$R_p = (R_e – LTE * R_{d*} (1-t))/ (1 + LTE)$

[22] Booth, Marcato (2004), p. 153
[23] Geltner, Miller (2007), p. 325

Where:

r_e= return on equity measured on the stock market

R_d= interest rate of debt

t= marginal tax rate

LTE= loan to equity ratio

(1-t) = tax shield

5.3 Unsmoothing

After adjusting the listed returns, we also have to adjust the direct returns. By analyzing the difference of transaction prices to appraisal values, two influencing components of the appraisal values can be distinguished.

5.3.1 Stale Appraisals

Appraisal values are relatively price inelastic. They don't go down as fast as the transaction prices et vice versa. This behavior is called price- "stickiness" and is also observed at consumer prices. Appraisers don't like to change their opinion fast.[24]

5.3.2 Lagging Bias

The basis on which the appraisals are founded on is in the past, as there are not enough current transaction comparables for precise price detection available. The length of the lag and the

[24] Geltner Miller (2007), p. 679

weight of the previous time periods influencing current appraisal values must be determined appropriately[25].

The intervals of the appraisals together with the baseness of their valuation on the past transaction prices leads to a lagging effect in form of a moving average of the returns which reduce the volatility and therefore the risk measurement beta for the systematic risk compared with a non lagging risk measurement[26]. In order to make investments comparable, an algorithm of un- smoothing the appraisal values must be applied.

5.3.3 Mechanical de-lagging

The influence of the past transaction prices appear in the current appraisals[27] in a filtered form. In the mechanical way, the idea is to correct this appraisal lag bias by reversing the "filtering" process to retrieve the data for each period of time[28].

5.3.3.1 The Fisher Geltner Webb Model

Briefly, the FGW model takes the following form[29]:

$$r^*_t = w_0 r_t + w(B) r_{t-1} \qquad (1)$$

Where r_t^* is the smoothed return index during period t, r_t is the corresponding underlying true or unsmoothed return during period t, w_0 is a weight between 0 and 1 and $w(B) = w_1 + w_2B + w_3B^2 + \ldots$, and B is a lag operator.

Substituting and expressing r^*_t in terms of present and past values of r^*_{t-1}, we get

[25] Geltner, Miller (2007), p. 678
[26] Geltner, Miller (2007), p. 669
[27] Gelnter, Miller (2007), p. 681
[28] Geltner, Miller (2007), p. 681
[29] Fisher, Geltner, Webb (1993), p. 2

$$r^*_t = \varphi(B) r^*_{t-1} + e_t \quad (2)$$

where $\varphi(B) = \varphi_1 + \varphi_2 B + \varphi_3 B^2 + \cdots$ is a lag operator polynomial and $e_t = w_0 r_t$.
It is convenient to write the autoregressive representation in (2) as[30]:

$$r^*_t = (\varphi_1 + \varphi_4 B^3) r^*_{t-1} + e_t \quad (3)$$

The first-order lagged value r^*_{t-1} is included in (3) to capture the tendency of appraisers to use a Bayesian updating rule. The fourth-order lagged value $B^3 r^*_{t-1}$ is included in (3) to deal with the fact that many properties are effectively reappraised only annually occurring in the fourth calendar quarter.

The foremost requirement in (3) is that e_t be regarded as a random variable that has a normal distribution with mean 0 and a constant variance σ^2. It follows from this assumption that the conditional distribution of r^*_t given r^*_{t-1} will be a normal distribution with mean $(\varphi_1 + \varphi_4 B^3) r^*_{t-1}$ and variance σ^2.

Solving (3) for r_t we are able to obtain the unsmoothed value of r_t^*

$$\mathbf{r_t = (r^*_t - (\varphi_1 + \varphi_4 B^3) r^*_{t-1} / w_0} \quad (4)$$

In turn, we can compute w_0 from the assumption that $\sigma(r_t) \equiv \sigma[r_t^* - (\varphi_1 + \varphi_4 B^3 r^*_{t-1})/w_0] \equiv \sigma^{SPI}/2$, where $\sigma[r^*_t - (\varphi_1 + \varphi_4 B^3 r^*_{t-1})/w_0]$ is some number based on the observable historical r_t^* series and the empirical estimation of φ_1 and φ_4, and σ^{SPI} represents the volatility of the SPI index of stock market values (in real terms). This condition amounts to assuming that the true volatility of commercial property values is approximately half the volatility of the SPI stock market index.

With this constraint on $\sigma[r^*_t - (\varphi_1 + \varphi_4 B^3 r^*_{t-1})/w_0]$, we obtain

$$w_0 = 2\sigma[r^*_t - (\varphi_1 + \varphi_4 B^3) r^*_{t-1}]/\sigma^{SMI} \quad (5)$$

[30] Fisher, Geltner, Webb (1993), p. 3

FGW use this condition to obtain values of r_t. FGW also use inflation-adjusted appreciation returns to estimate (3), the thought being that $E(e_t) = 0$ is more theoretically sound for real returns. Additionally, FGW adds a constant term φ_0 to (3) to make the mean of e_t zero. FGW's estimates are not fully efficient tough.[31]

This complex method is rarely used in practice as the input factors are not provided and cannot be determined easily. Therefore, simplified methods for correcting the auto- correlation are applied.

5.3.3.2 Two period un- smoothing

A simplified possibility to correct for bias is the following formula for a two- period moving average lag[32]:

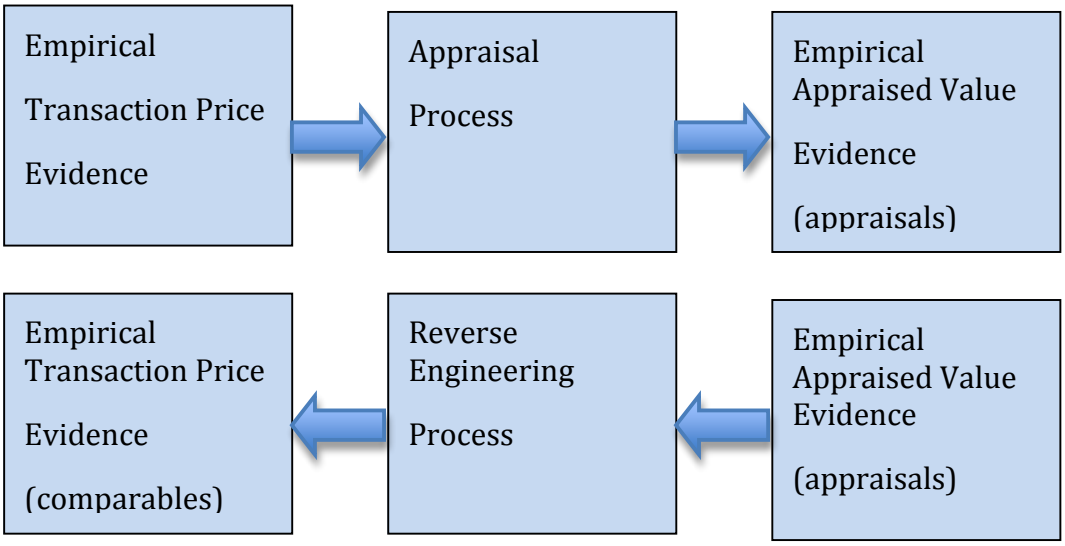


Illustration 2: Umsmoothing process

[31] Cho Hoon, Kawaguchi Yuichiro (2001), p.3
[32] Geltner, Miller (2007), p. 669

Suppose the value of an asset is dependent on the values of the asset before weighted with the average current price and the average previous price:

$$V^*_t = w_0 V_t + (1-w_0) V^*_{t-1}$$

This equation is a first-order auto-regressive model with v^*_t the current appraisal, v^*_{t-1} the previous appraisal and V the contemporaneous transaction evidence.

We can convert the equation from value to levels of return and have:

$$R^*_t = w_0 r_t + (1-w_0) r^*_{t-1}$$

and solve the equation for the contemporaneous price[33]:

$$r_t = (r^*_t - (1- w_0) r^*_{t-1})/w_0$$

4.5.3.3 Simple one- step autocorrelation procedure

While more complex approaches like the Fisher Geltner Webb Method, the two period model or other complex approaches allow the problems of stale appraisals and lag bias to be addressed explicitly, the older "simple one step" approach works well for indices with a yearly appreciation frequency.[34]

Because this method is so simple, it is used widely in theoretical and empirical studies. It will also be used to unsmooth the swiss IPD index later in this thesis.

The one step model is basically the two period model with a fixed weight of 0.4 for the past and 0.6 for present appraisal values.

[33] Geltner, Miller (2007), p. 682
[34] Fisher, Geltner, Webb (1993), p.683

This implies that the average lag being corrected for which implies the appraisal lag and the stale appraisals effect, is[35]:

$L=1/w_0 - 1 = 1/0.4 - 1 = 2.5 - 1 = 1.5$ (periods)

5.4 Comment

The methods of deleveraging and un- smoothing are strong tools to make returns of direct and indirect investments comparable. They "distill" the unlevered real return of an investment and correct for the flaws of human made appraisals based on past data.

[35] Fisher, Geltner, Webb (1993), p.683

6 Macro level analysis

6.1 Asset class comparison

In the investment world, in advisory based and in discretionary models, Real Estate as an asset class became increasingly important driven from the increasing demand of investors. Investors are specially looking for the stable and sustainable income stream this asset class can deliver. Yields between these of bonds and equity are offered. Real Estate is known to give the investor a feeling of owning something substantial with physical value, which can be seen and touched and gives the owner a shelter over it's head in the worst case. This short excerpt into the motives of investors of Real Estate gives an impression of the emotional behavioral factors equally important for a decision to invest in Real Estate. Real Estate like other asset classes bears an inherent risk and is not risk free. Their risk- return profile must be viewed in relation to other competing asset- classes like bonds, equities, commodities and hedge funds[36]. Illustration 3 shows the performance of the largest swiss equity, bond and real estate indices for the last 3 years.

A high correlation of the SXI Real Estate Index with the Swiss Market Index SMI is observable, as well as a low correlation of the bond index SBI with the Real Estate and Equity index. Illustration 3 shows that the long hedged assumption that real estate is correlated with equity, at least in the short term, is also strengthened for the swiss market.

[36] Sing (2002), p. 189

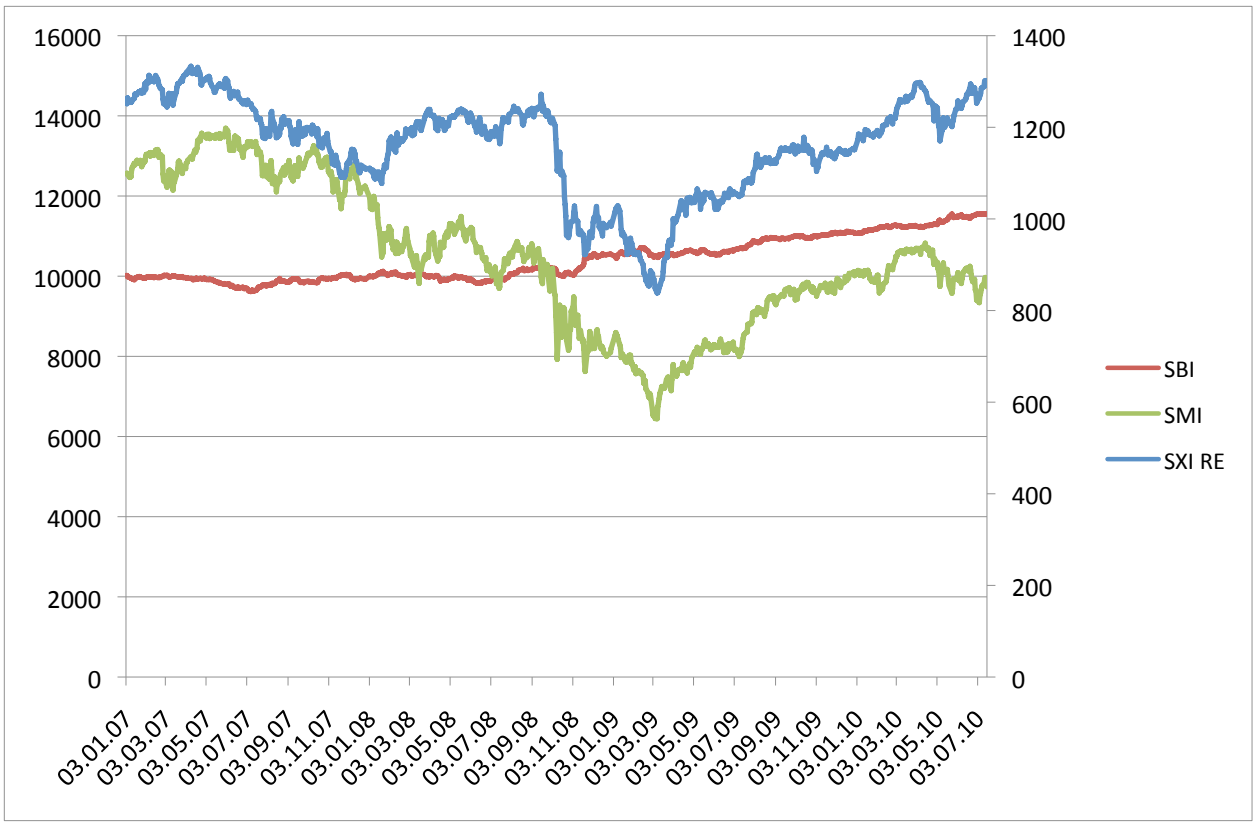


Illustration 3: Performance comparison of different asset classes

Illustration 4 shows in a longer time- series the strong correlation of the swiss equity market to the listed real estate from 2000 to 2009 on a daily basis. We observe the burst of the dot-com bubble in 2001, the fast recovery thereafter, followed by the financial crisis in 2007 strongly influenced the listed real estate market. The correlation of listed real estate equity to the stock index is high, although the gap becomes bigger the more years observed[37].

Illustration 4: SMI vs. SXI RE on daily basis

[37] Gyourko, Keim (1992), p.460

Studies conducted by Morgan Stanley show a similar picture for the UK stock and indirect real estate market[38]. Illustration 5 shows that relationship for the UK market.

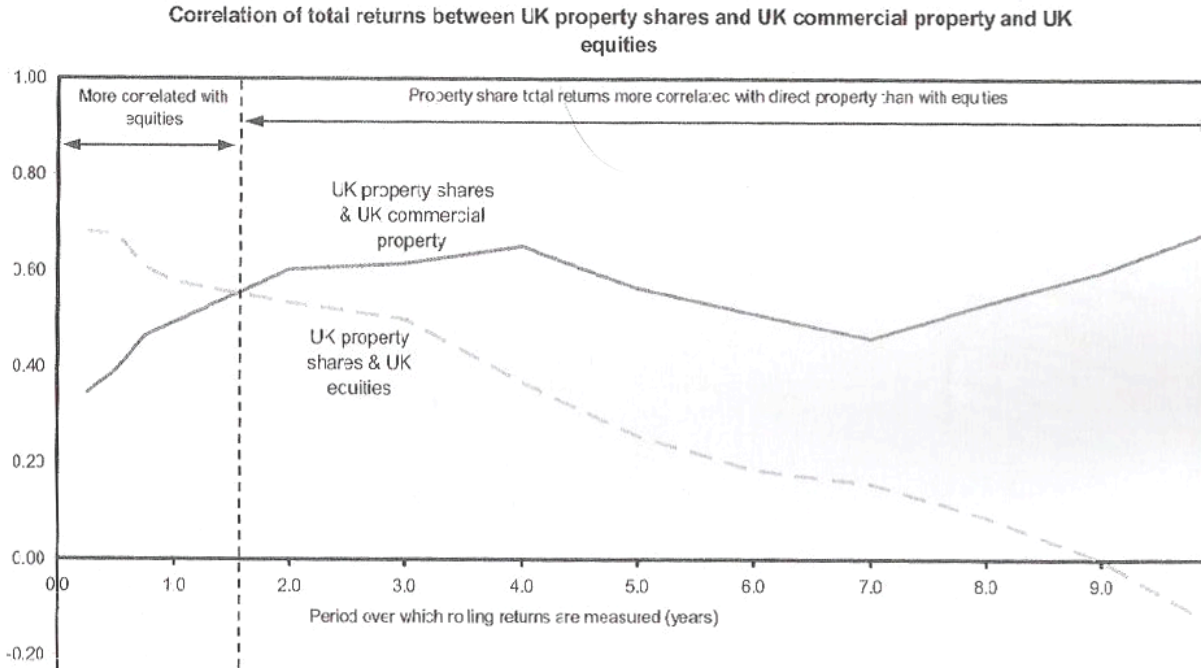


Illustration 5[39]: Correlation of property shares with equity in the short- and long term

6.2 Data

To compare Real Estate on an index level, two indices must be defined and made comparable. For this purpose with regards to our research of the Swiss Real Estate market, we chose to compare the direct IPD CH index with the indirect SXI Real Estate Fund index.

The IPD CH measures the performance of direct investments in swiss real estate on an appraisal basis. It is the broadest measure for direct real estate in Switzerland. The other frequent used swiss direct index, the IAZI index, is a hedonic index and therefore can't be used for this analysis.

[38] Allen, Gysens, Carroll, Riemer (2009), p. 1
[39] Allen, Gysens, Carroll, Riemer, (2009) p. 2

The SXI Real Estate Fund index was chosen due to representativeness for the swiss real estate market and the availability of data as there was not enough data for the SXI Swiss Real Estate index beginning in 2010.

The total return of the IPD CH index and its sub- indices are shown on illustration 6 from 2002 – 2008.

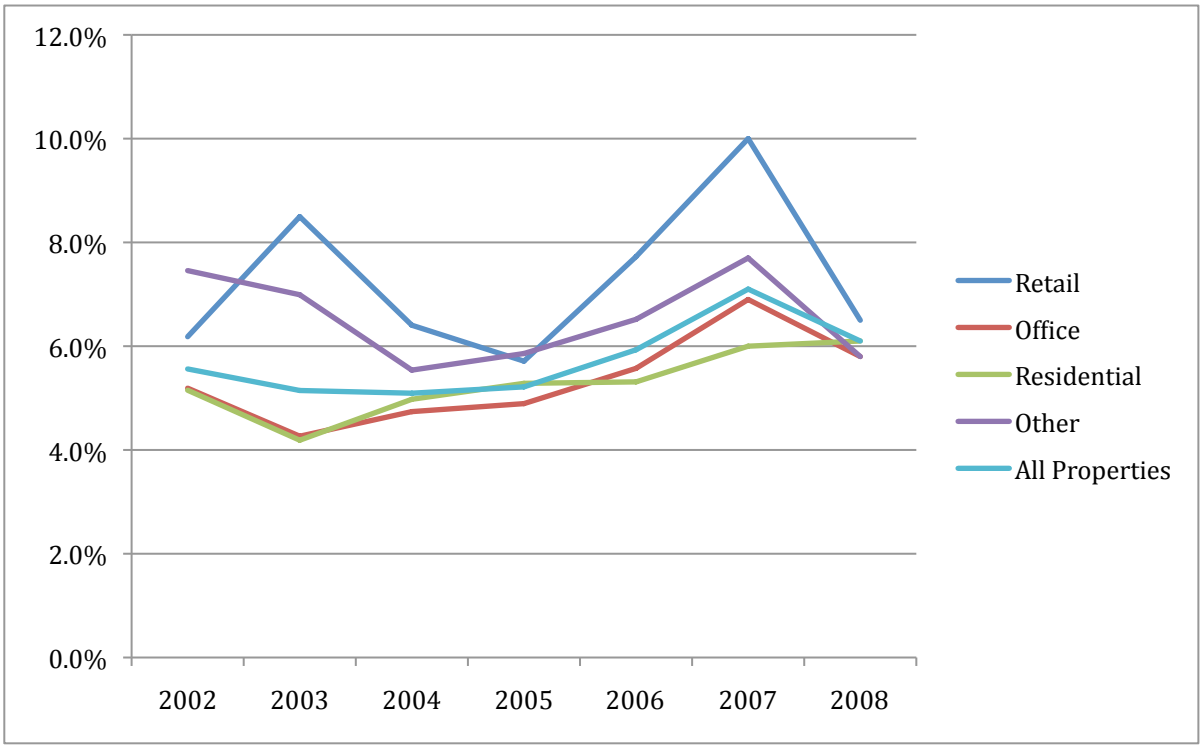


Illustration 6: Types of property

The indirect SXI Real Estate Fund index consists of 100% shares of Real Estate Funds listed at the SIX Swiss Exchange. Illustration 7 shows the family of the SXI Indices[40].

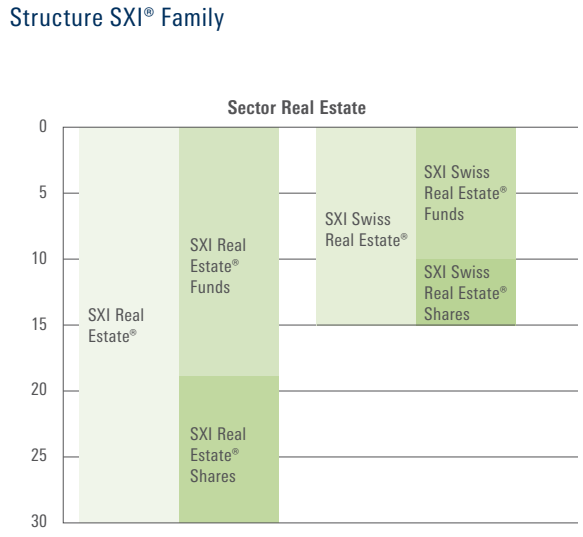


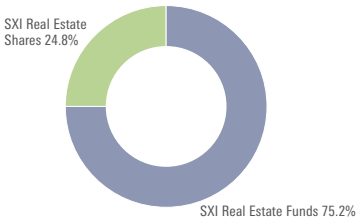
Illustration 7[1] : SXI Real Estate family

The SXI Real Estate Fund index currently has the following constituents with the weights seen on illustration 8. The SXI Real estate Index also has some foreign real estate exposure as some of these at the SIX Swiss Exchange listed funds have a small exposure to foreign real estate[41].

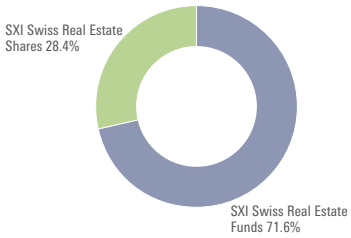
[40] SIX Swiss Exchange (2010)
[41] SIX Swiss Exchange (2010)

Basket compositions and weightings as of 30.12.2009

SXI Real Estate®



SXI Swiss Real Estate®



		SXI Real Estate®	SXI Real Estate® Shares	SXI Real Estate® Funds	SXI Swiss Real Estate®	SXI Swiss Real Estate® Shares	SXI Swiss Real Estate® Funds
Shares	SWISS PRIME SITE N	9.57	38.51		11.82	41.65	
	PSP N	7.03	28.30		8.69	30.61	
	MOBIMO N	2.97	11.95		3.67	12.93	
	ALLREAL N	2.24	9.03		2.77	9.77	
	INTERSHOP I	1.16	4.66		1.43	5.05	
	WARTECK N	0.65	2.61				
	ZUEBLIN IMM N	0.54	2.19				
	BFW LIEGENSCHAFTEN N	0.37	1.48				
	USI GROUP N	0.17	0.69				
	PAX N	0.14	0.58				
Funds	UBS SWISS SIMA	15.53		20.66	19.19		26.80
	CS REF LIVING PLUS	7.42		9.88	9.17		12.81
	CS REF SIAT	7.08		9.42	8.75		12.21
	UBS SWISS ANFOS	5.66		7.53	7.00		9.77
	CS REF INTERSWISS	4.67		6.21	5.77		8.05
	CS REF PROPERTY PLUS	3.89		5.17	4.80		6.71
	SWISSCANTO IFCA	3.83		5.10	4.74		6.62
	IMMOFONDS	3.53		4.70	4.37		6.10
	SCHRODER IMMOPLUS	3.17		4.22	3.92		5.47
	SOLVL 61 PRT	3.16		4.21	3.91		5.46
	UBS SW SWISSREAL	3.07		4.09			
	LA FONCIERE	2.86		3.80			
	UBS FONCIPARS	2.62		3.48			
	FIR	2.62		3.48			
	SWISSINVEST REAL	1.82		2.43			
	Immo Helvetic	1.36		1.81			
	BONHOTE IMMOBILIER	1.20		1.60			
	DREF	0.95		1.27			
	PROCIMMO	0.71		0.94			
	Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Illustration 8: Constituents of the SXI Real Estate Funds TR Index

6.3 Analysis

6.3.1 Deleveraged SXI Real Estate index

To deleverage the returns of the SXI Real Estate Funds index, we use an average loan to equity ratio of the swiss funds in the index over the last 10 years of 30%.

Illustration 9 shows the years of positive economic growth before the recent financial crisis of 2001- 2006 where the unlevered return on investment was lower than the return of the levered investment. In the years of the crisis of 2007 and 2008, the unlevered return was generally higher due to the negative impact of leverage when prices were falling.

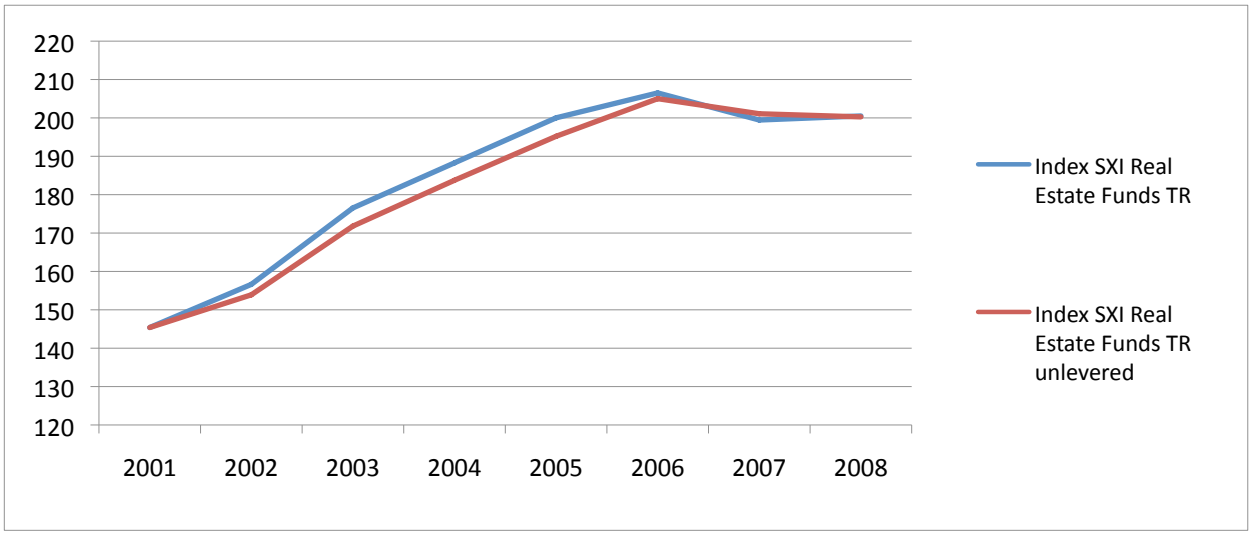


Illustration 9: Levered vs. unlevered SXI RE Funds TR

6.3.2 Unsmoothed IPD

For calculation of the unsmoothed IPD, we use the one step autocorrelation approach described earlier. Illustration 10 shows the comparison between the IPD and its unsmoothed version. The relatively low deviation is best explained by the only yearly measurement of the IPD, and so the "unsmoothed" graph still looks pretty stable. Please note that in the years of the crisis of 2007 –

2009, the IPD remains positive, especially the unsmoothed IPD with an even bigger growth rate. The red and green bars in the graph indicate the delta between the two indices.

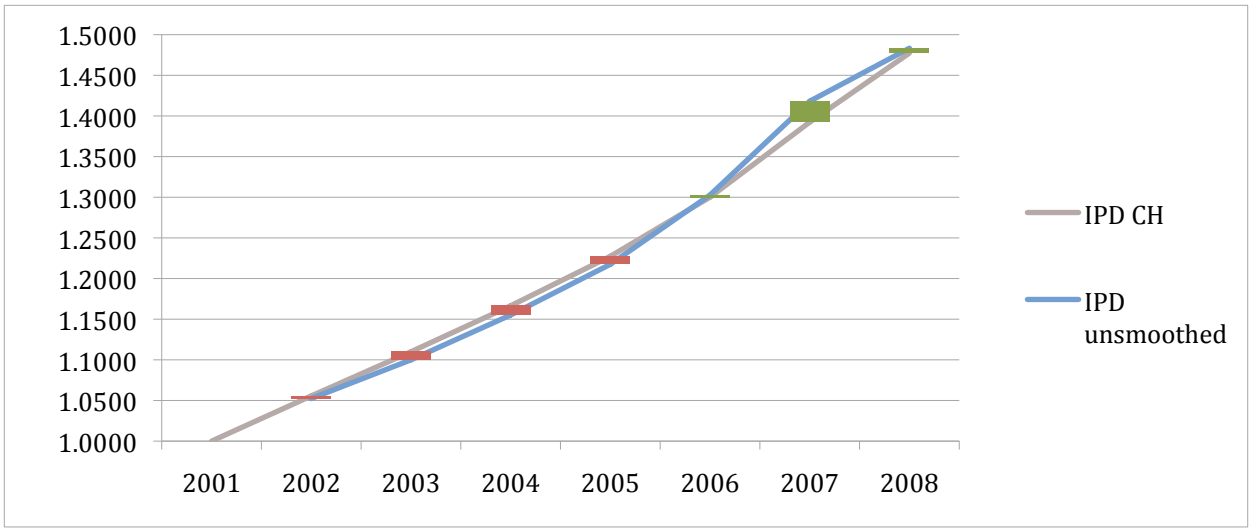


Illustration 10: smoothed vs. unsmoothed IPD CH index

6.3.3 Comparison of direct and indirect index

The analysis of the data on illustration 11 shows the different character of the two indices compared. The listed indirect Real estate fund SXI Real Estate Fund Total Return is much more volatile than the valuation based direct IPD CH index. We can see that the "reaction" of the IPD to the movement of the SIX RE Funds index comes with a certain lag[42]. The SXI RE total index has its highest value at the end of 2006, whereas the IPD still shows positive growth. We observe lower growth rates for the IPD after the end of 2007 though. This empirical finding shows a lag in the reaction of the IPD to the SXI. The IPD still had never had any negative growth rates.

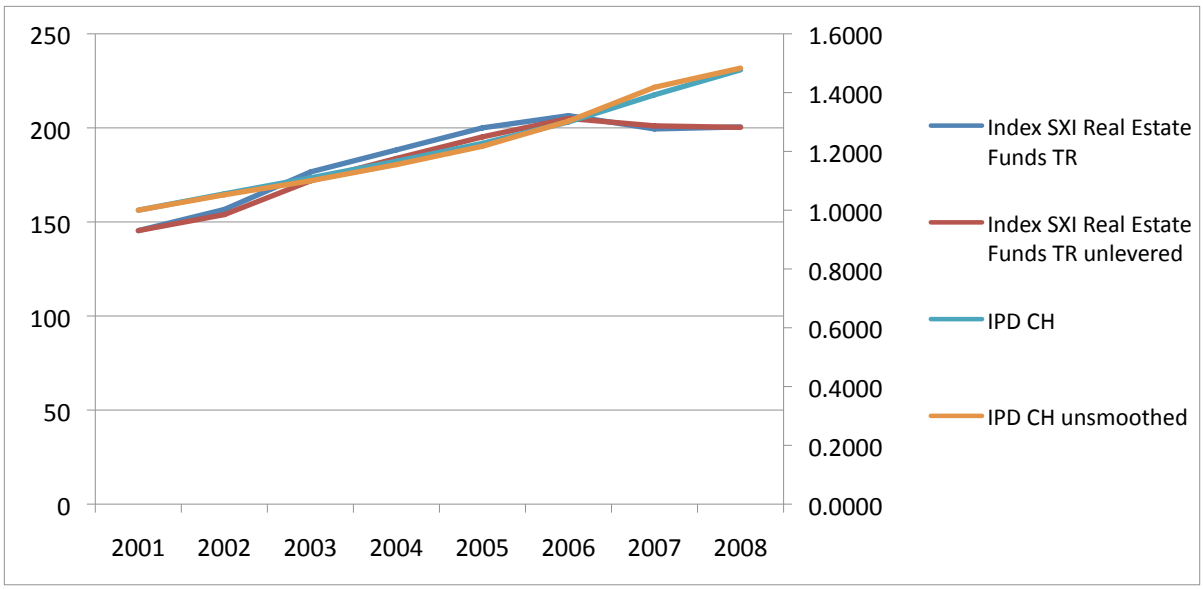


Illustration 11: Comparison SXI vs. IPD indices

As Illustration 11 shows a lag of the IPD to the SXI of one period, that means one year for us. To achieve transparency to understand the correlation of the two real indices[43], the values must be adjusted for the lag. The IPD corrected for one period can be seen on illustration 12. We clearly observe a decrease of growth of the IPD together with a negative performance of the SXI Real Estate Fund index beginning in 2006.

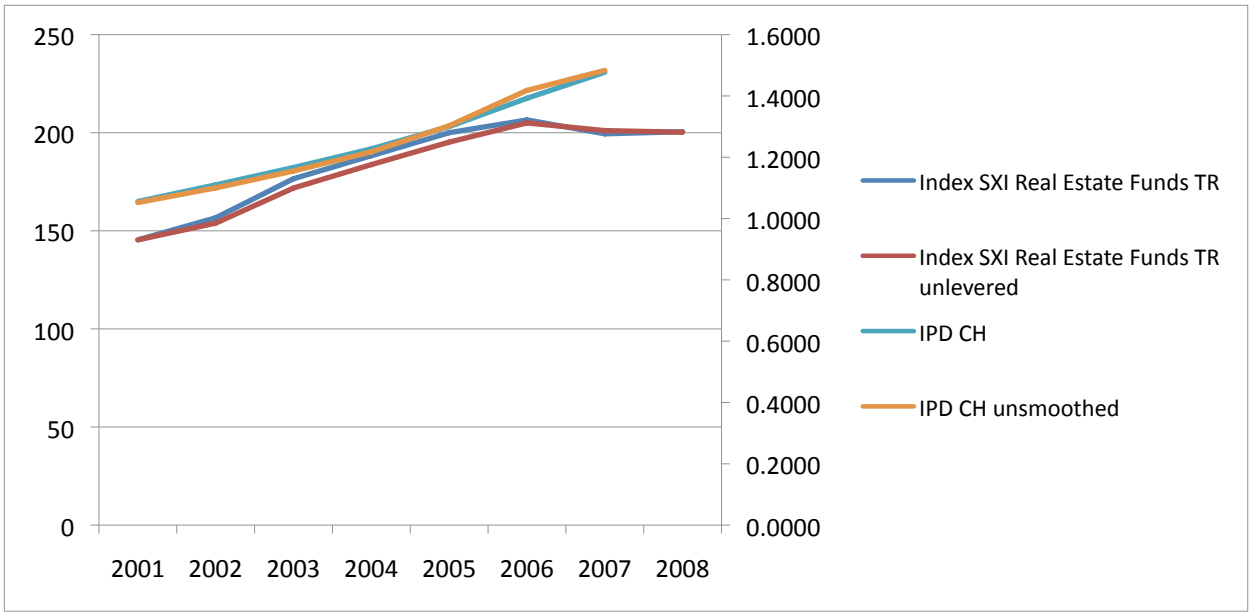


Illustration 12: SXI RE Fund vs. IPD CH indices corrected for lag

[43] Sing, Sng (2003) p. 367

6.4 Dependency between direct and indirect markets

To measure the correlation of the various annual data series of returns from direct and indirect real estate investments, we calculated different correlation indices ranging from the Pearson correlation coefficient to the robust correlation to the rank- based Spearman coefficient.

6.4.1 Pearson correlation coefficient

The correlation coefficient is a parametric measure of correlation that takes into account all observations[44].

$$COR(X,Y) = COV(X, Y) / (\sigma x * \sigma y) = \sum_i^n (xi - x) * (yi - y) / (\sigma x * \sigma y)$$

where:

COR: Correlation between the two variables

COV: Covariance between the two variables

$\sigma_{x:}$ Standard deviation of variable x

$\sigma_{y:}$ Standard deviation of variable y

X: mean return of variable x

Y: mean return of variable y

[44] Geltner, Miller (2007), p.527

6.4.2 Robust correlation

The robust correlation coefficient removes those data points that form the 10% most outlying observations. For example, if we have extreme data points in our observations, the robust correlation would remove these points.

6.4.3 Kendall's tau

The Kendall tau index measures the difference between the probability of association and the probability of disassociation[45]:

$$K_{xy} = P((x_1-x_2)(y_1-y_2) > 0) - P((x_1-x_2)(y_1-y_2) < 0$$

If the product of these two differences is greater than zero, meaning when both factors are positive or negative, we have "concordance", if not, we have "discordance"[46].

6.4.4 Spearman rank correlation

This non-parametric measurement relates to the order of the data points in the series and not to their absolute value.[47]

$$S_{xy} = (\sum (Ai - A)\,(bi - B)) / (\sqrt{\sum} (Ai - A)^2 \sqrt{\sum}(Bi - B)^2)$$

[45] Booth, Marcato (2004), p. 155
[46] Booth, Marcato (2004), p. 155
[47] Booth, Marcato (2004), p. 155

where:

A_i = rank of x_i

B_i = rank of y_i

A = mean of all A observations

B = mean of all B observations

a_i = observation of a

b_i = observation of b

6.4.5 Correlation Analysis

Illustration 13 shows the comparison of the Pearson correlation coefficient to the robust coefficient calculated for our data ranging from 2002 – 2008. The "normal" correlation as referred to the Pearson correlation shows negative signs of correlation, which is difficult to understand. But when we proceed with eliminating the 10% most extreme data points to calculate the robust correlation, we have another picture of the dependencies of the indices. The SXI levered real estate index is not positive correlated with the smoothed IPD, but as soon as we unsmooth the IPD index, we get a strong positive correlation. Unlevering the SIX Index doesn't improve the correlation neither compared with the unsmoothed IPD nor with the ordinary IPD Index.

These results are in line with the findings from other European countries as well as with those from the United States. These studies confirmed the strong effect unsmoothing has on the correlation and what a weak or no effect deleveraging the return has on correlation[48].

[48] Booth, Marcato (2004), p. 157

It is important to mention at this point, that the negative Person correlation could also partly be explained by the influence the foreign properties have which are a minority share in the portfolios of the constituents of the SXI RE Fund Index.

The Kendall's tau and the Spearman rank correlation show the same results as the Pearson correlation coefficient and are therefore not specially illustrated.

Correlations	Pearson correlation coefficient	Robust Correlation
IPD vs. SIX Real Estate Fund	-0.337748832	-0.439314648
Unsmoothed IPD vs. de- geared SIX Real Estate Fund	-0.614261197	0.397983397
IPD vs. de- geared real estate shares	-0.815459333	-0.426654741
Unsmoothed IPD vs. SIX Real Estate Fund	-0.240615085	0.40951096

Illustration 13: Correlation coefficients

7 Micro fund level analysis

At the micro level, we compare the unleveraged total returns of two funds with the unsmoothed appraisals of the underlying expressed as the NAV. The difference to NAV, the agio (disagio) can be viewed as an excess demand (supply) for the investment fund observed.

For empirical analysis, we chose the two biggest mainly in swiss residential real estate investing funds listed on the SIX Swiss Exchange, which are the Credit Suisse Interswiss and the Schroders ImmoPlus funds.

7.1 Credit Suisse Interswiss

7.1.1 Data

Maximum Loan to value	50% (KKV Art. 96 Abs. 1)
Net assets	CHF 1’232 Mio.
Market value Real Estate	CHF 1’653 Mio
Benchmark	SXI Real Estate Funds
Rental loss	3,53%
Cost (TERREF)	0,71%

*: data per 31. 07. 20010

CS Interswiss[49]	2002	2003	2004	2005	2006	2007	2008	2009
debt to equity ratio	26.7%	32.2%	31.7%	35.0%	39.2%	30.3%	27.8%	33.1%
loan to value LTV	21.1%	24.3%	24.1%	25.9%	28.1%	23.3%	21.8%	24.9%
cost of interest	4.7%	3.3%	3.3%	2.5%	2.3%	2.9%	3.3%	2.3%
tax	4.8%	8.5%	12.0%	15.7%	11.5%	8.1%	8.8%	7.6%

Beta to Market: 1.2

Illustration 14: Data CS Fund Interswiss

7.1.2 Distribution

The Credit Suisse Investment fund mainly invests in residential real estate with minority stakes in commercial and office space.

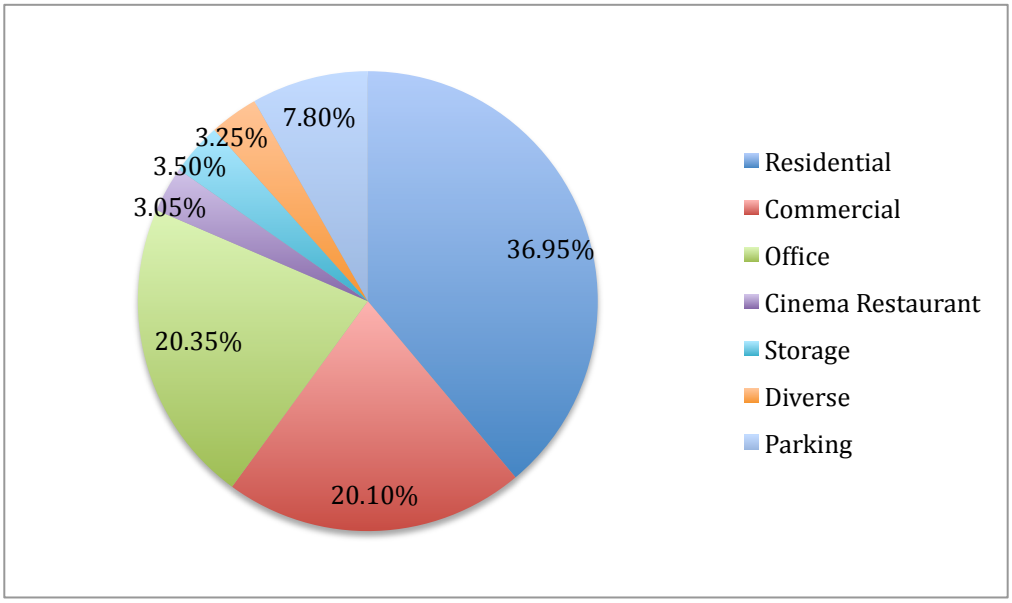


Illustration 15: Asset distribution CS fund Interswiss

[49] Credit Suisse Asset Management (2010)

7.2 Schroder ImmoPlus

7.2.1 Data

Schroder ImmoPlus[50]	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
debt to equity ratio	37.6%	26.8%	27.1%	27.1%	47.5%	29.4%	26.7%	22.3%
loan to value LTV	27%	21%	21%	21%	32%	23%	21%	18%
cost of interest	4.1%	4.3%	3.7%	4.0%	2.5%	3.7%	3.2%	3.1%
tax	5.2%	11.1%	10.0%	10.3%	6.2%	10.6%	3.4%	3.8%

Beta to Market: 0.9

Illustration 16: Data Schroder Fund ImmoPlus

The ratio which changes most is the leverage shown on the debt to equity and loan to value ratio. It is especially variable due to capital appraisals of the real estate values. It has the greatest impact on performance, followed by cost of interest and taxes.

7.3 Analysis

To be able to compare returns, the leveraged net of tax return has to be adjusted by deleveraging with the adequate cost of interest and adjustments for the tax shield of debt financing must be made.

We used the formula below discussed earlier for adjustment of the returns[51]:

$R_p = (R_e – LTE * R_{d*} (1-t))/ (1 + LTE)$

[50] Credit Suisse Asset Management Funds (2010)
[51] Booth, Marcato (2004) p. 153

7.3.1 CS Interswiss Real Estate Index

On illustration 17, the levered CS REF Interswiss index is compared with the unlevered index net of tax. There is strong correlation between the two indices with an outperformance of the unlevered index beginning of 2007. This so called negative leverage results in systematically lower $R_{leverage}$ than $R_{unleverage}$. This is the case in times when total property returns of equity investors are lower than cost of debt, as it happened to be in 2007 – 2009 in the times of the latest financial crisis.

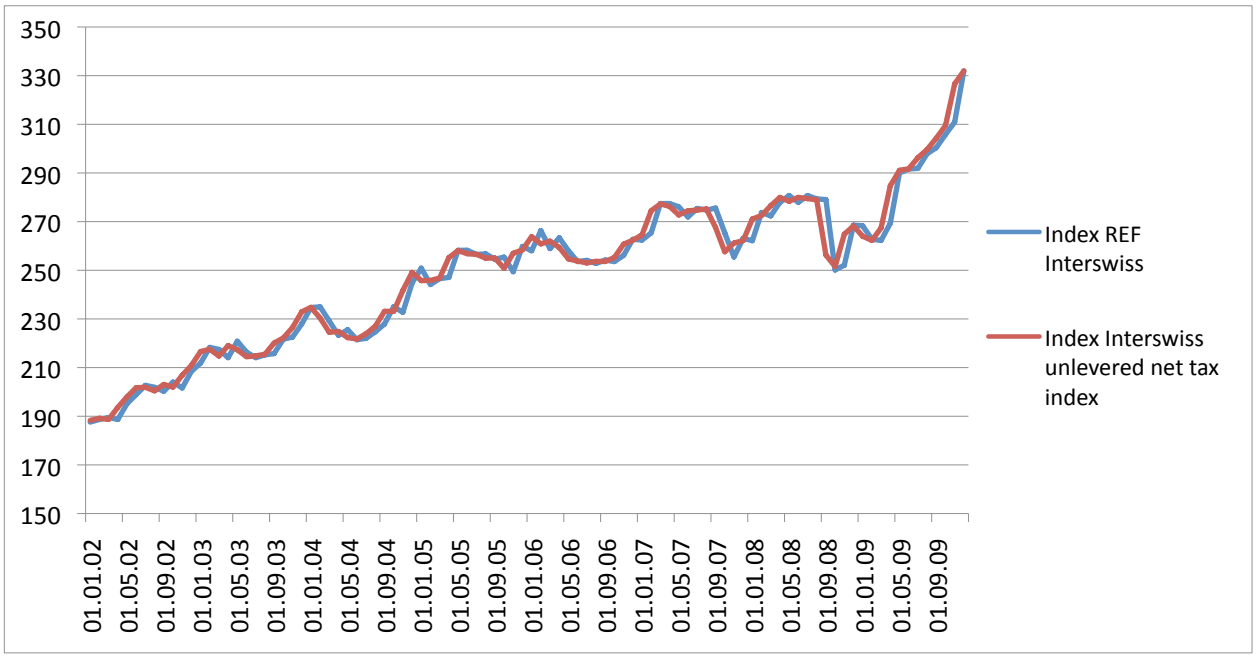


Illustration 17: Levered vs. unlevered Interswiss fund

Illustration 18 shows the comparison on the index level of the two funds with its monthly returns. The monthly returns are very volatile. The unlevered index, which is less volatile than the levered one, reacts less to the underlying property returns and is more correlated with the unlevered yields. A period of exceptional high volatility is observed at the end of 2008 until present where the amplitude of the property yields gets higher. From the beginning of 2009, historically very high yields are driving the index higher at an above the average rate.

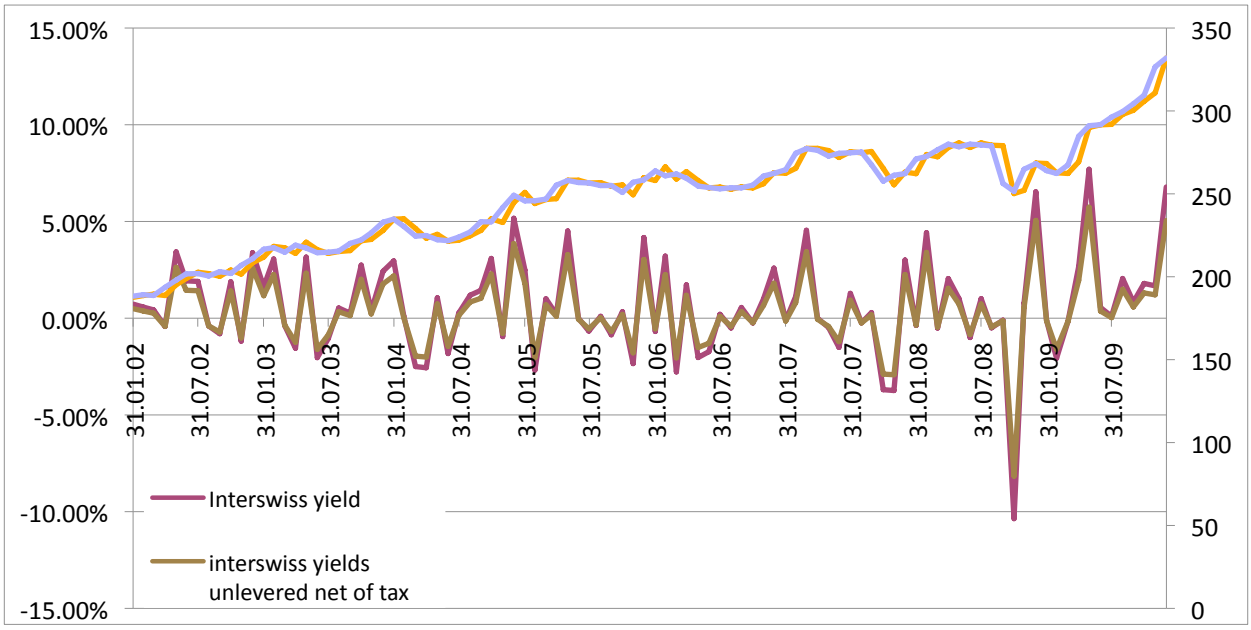


Illustration 18: Interswiss yields vs. indices

Illustration 19 adds the agio of the CS interswiss fund to the index and yield comparison. We observe a big agio from 2002 – 2006 nearly turning negative on January 2009. This makes sense, as the listed real estate funds were hit by the financial turmoil of the stock markets. But very fast, they recovered from the low on January 2009 and have a positive agio of around 25% again.

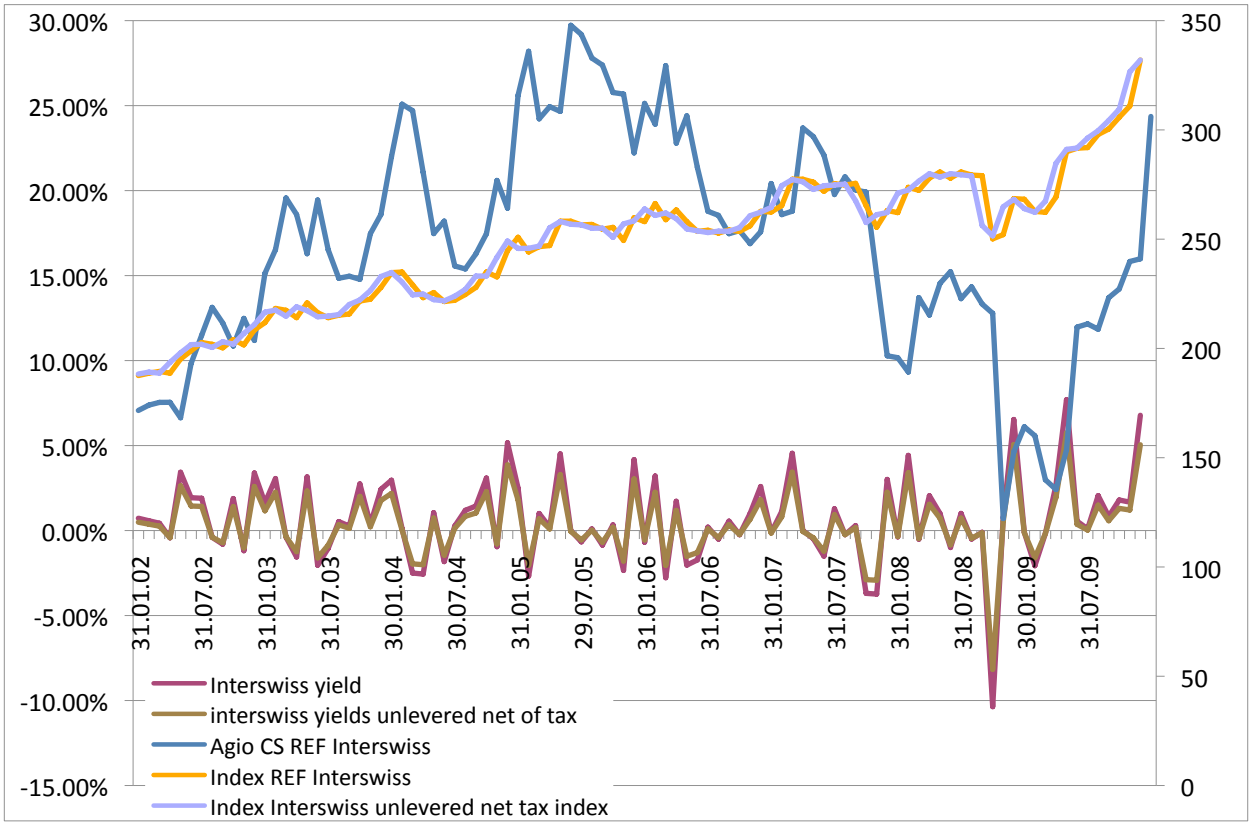


Illustration 19: Interswiss yields, indices and agio

7.3.2 Schroder Immoplus Total Return

After analyzing the CS Interswiss fund, we look at the Schroder ImmoPlus fund, the other big swiss real estate fund mainly investing in swiss residential real estate[52]. The yields of the levered fund are slightly bigger due to lower interest rates on debt than return on investment.

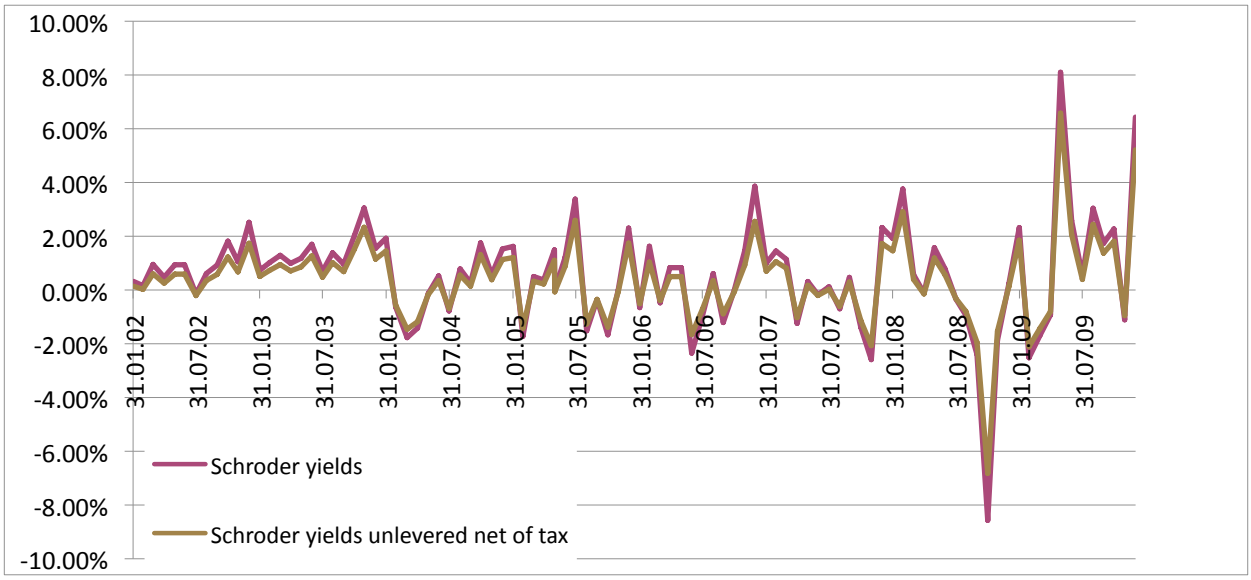


Illustration 20: Schoder ImmoPlus yields

[52] Credit Suisse Asset Management (2010)

Illustration 21 compares the same on an index level. The correlation between the two indices is very strong with a slight outperformance of the levered fund in times of strong economic growth and underperformance in times of weak economic growth.

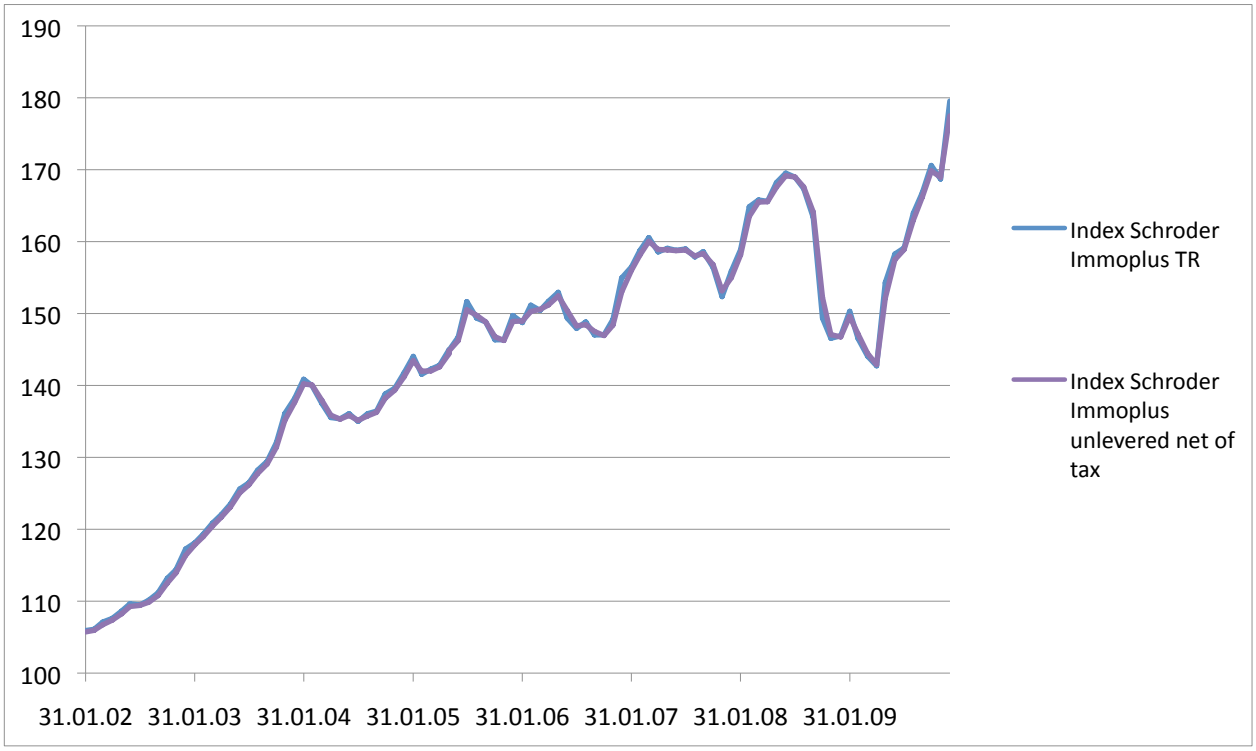


Illustration 21: Schroder ImmoPlus indices

By adding the monthly yields to the index, the turning points become clearly visible. The higher volatility beginning of 2003 turns into a strong monthly negative performance at the end of 2008 marking the beginning of the downturn until beginning of 2009 when the yields recovered by a merely as high upswing.

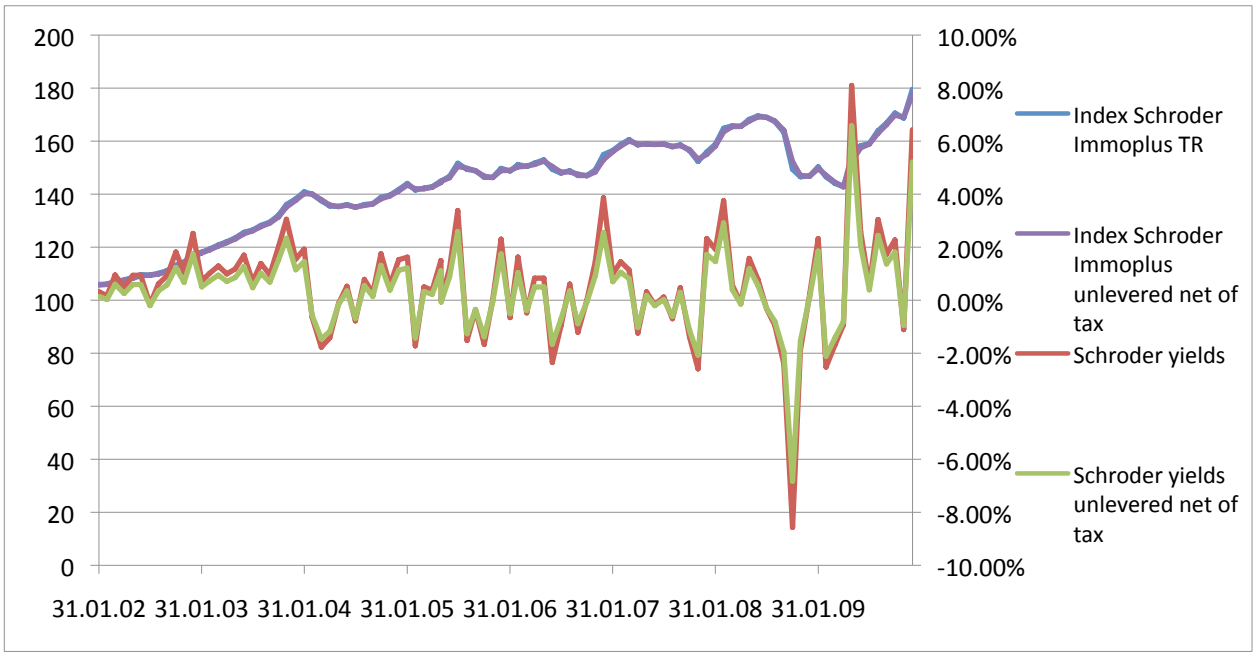


Illustration 22: Comparison Schroder ImmoPlus yields vs. indices

Illustration 23 adds the agio as the connection to a valuation based measurement to our analysis of the Schroder Immoplus index. The very fast drop of the agio[53] of merely 30% from the beginning of 2007 to the end of 2007 is remarkable, especially when compared with the drop of the Schroder index, which was only about 12%. This can be explained by the excess demand of direct real estate markets in times of the financial crisis, which led appraisers to value real estate higher due to very low interest rates, what diminished the agio on the indirect investments. When financial markets began to recover in 2009, the agio recovered by rising fast to the heights of 2007. A possible explanation could be the new interest of financial investors for real estate is what drove the agio higher but not so much the index what could be explained that the appraisers of the direct real estate were still correcting their appraisals downwards. This illustration makes the basis effect of appraisals very transparent.

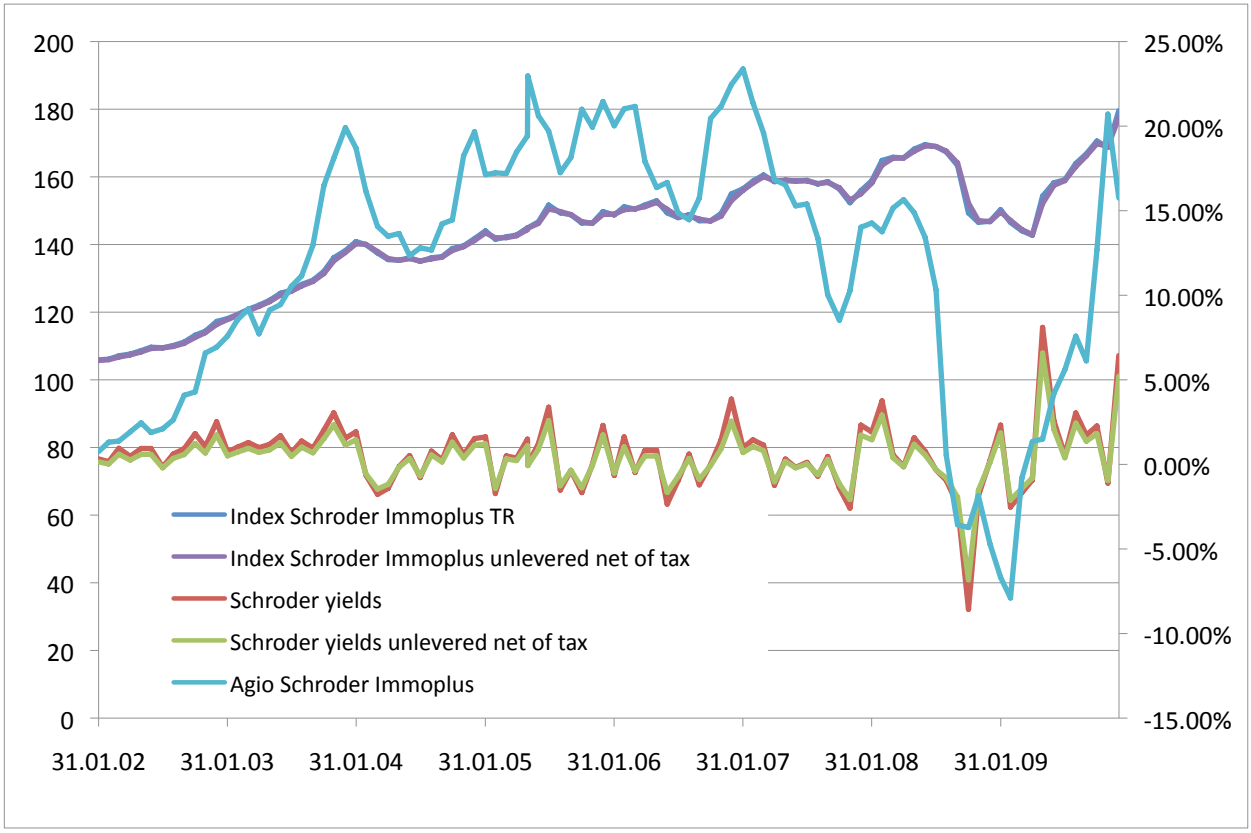


Illustration 23: Schroder yields, indices and agio

[53] Credit Suisse Private Banking Real Estate Advisory (2010)

7.3.3 Interfund comparison

At illustration 24, we compare the indices of the two real estate funds CS Real Estate Interswiss and Schroder Immoplus TR with its agios together with the aggregated agio of the swiss real estate universe. The agios, as well as the indices show strong correlation with each other as assumed initially. It is observed at both funds that the indices don't fall as much as the corresponding agio does, which we explained earlier with the "smoothing" effect of the based appraisal values, which are lagging the valuation of the market. They are still revised upwards in the downswing of the markets leading to lower agios and revising down in an upswing market making the agio bigger again.

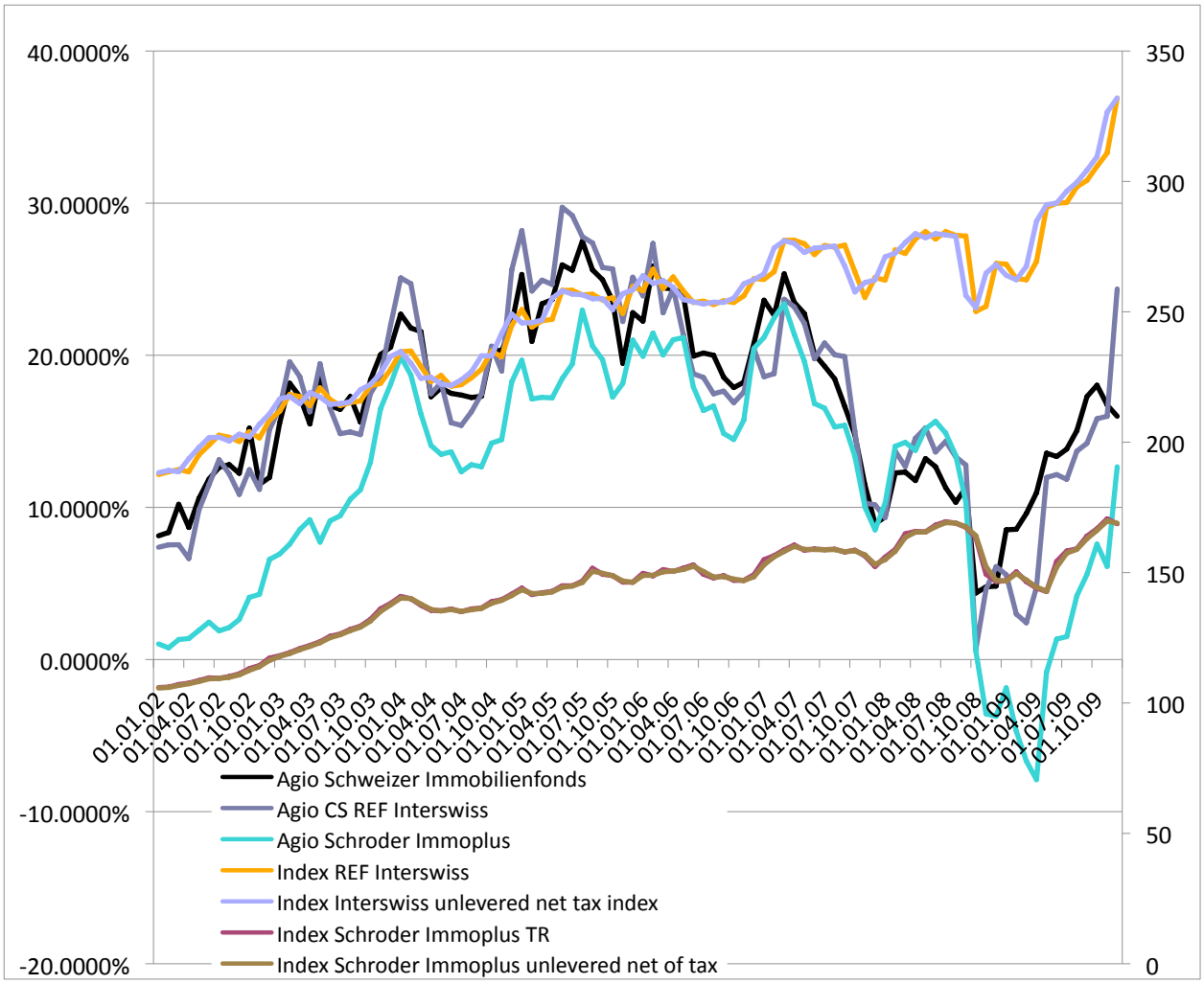


Illustration 24: Comparison all data Schroder ImmoPlus vs. CS Interswiss

8 Implications for asset allocation decisions

Following the results of this thesis about the correlation of the swiss direct and the swiss indirect real estate market and its gap due to information efficiency, we can derive different investment strategies from the simple arbitrage model to more sophisticated approaches like timing indications of the listed real estate sector to achieve better performances than just investing in either direct or indirect real estate.

8.1 Arbitrage

An investor who perfectly acts out of the information of the listed real estate indices, could have invested in listed real estate in 2002 and switch to direct real estate in 2006. This strategy would have generated fare more returns than investing 100% in listed or 100% in direct real estate or with a fixed ratio of 50% direct and 50% indirect real estate.[54]

8.2 Signal for Asset Allocation

Using the indicating effect of listed real estate for tactical decisions or timing decisions by decreasing or increasing the weights of strategic allocations, investors can achieve significant higher returns by incorporating them into their overall asset allocation.

8.3 Limitations to methodology

While this thesis shows that the comparison of direct and listed returns provide valuable information that help to maximize returns over the long term, there certainly are some limitations.

[54] Crowe, Krisbergh (2009), p. 9

8.3.1 Timing

One problem to keep in mind is the amount of time it takes to buy and sell direct real estate[55]. If it takes more than one year to invest in direct real estate, the average lead of listed real estate over direct real estate, then this information given by the listed market is useless.[56] It would be impossible to achieve superior profit from this information.

An example is the following:

When the listed markets is at its high and indicates that it is time to invest in direct property, but liquidity is tight there, an option would be to invest in unlisted open- end fund instead. But with that strategy, probably not all theoretical possible price gains could be achieved. In practice, however, as listed markets peak, liquidity is still usually plentiful which will help sell the shares, and in trough liquidity is scarce, but providing equity buyers more opportunities with investing in direct real estate. So, market liquidity also depends on the structure of investments. The liquidity and the grade of securitization of the various types of investment in real estate are shown in illustration 25[57].

Illustration 25: Characteristics and types of real estate investments

[55] Stevenson (2001), p. 15
[56] Crowe, Krisbergh (2009), p. 10
[57] Crowe, Krisbergh (2009), p. 10

Another problem is to determine if the listed market has hit a peak or a trough. It is always possible that returns experience a minor correction but then continue the upward trend, or vice versa. Additional time would be needed to become clear of the direction of the trend. That also can diminish the time available to react to indirect market indications[58].

Although, there are different factors that help to determine if a trend is over:

Economic Cycle: Is the market closer to the beginning or the end of an economic cycle

Amount of correction: The magnitude of the downturn in listed prices[59]

8.3.2 Quality of direct market valuations

There are issues with the quality of the direct real estate data. In Switzerland, data is gathered by IPD Switzerland only on a yearly basis based on appraisal values. In other countries like the UK and the US, data is available on a monthly basis and is therefore more accurate.

8.3.3 Active management and composition

Another point of explaining the differences in returns between direct and indirect real estate investments are active management and composition[60].

Listed property companies or listed funds are active managed structures that try to add value to their real estate investments, although not always with the same success. Management can also act on changes of fundamentals through acquisitions and disposals and can undertake development or repositioning activities. Generally, these companies have additional sources of income than just the rental income, such as asset management fees or transactional fees. This varies by country, but it is similar for Switzerland, where is no data available. Other European countries such as UK or Netherlands are shown on illustration 26.

[58] Crowe, Krisbergh (2009), p. 9
[59] Crowe, Krisbergh (2009), p. 10
[60] Crowe, Krisbergh (2009), p. 11

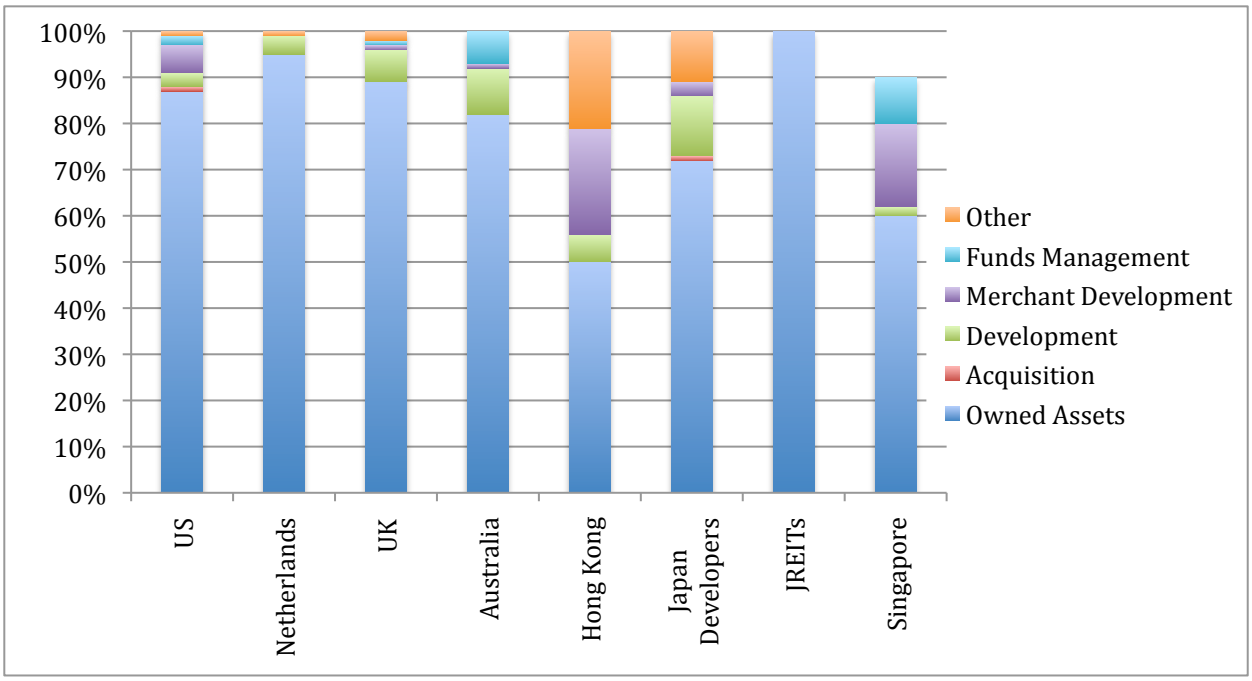


Illustration 26: Income composition

9 Conclusions

Our analysis of different swiss real estate markets shows a correlation of returns of direct and indirect real estate markets. This can only be observed by comparing the robust correlation, which eliminates the 10% most extreme points and by adjusting the direct real estate index for the basis effect the appraiser given values have. This so called unsmoothing shows the correlation of the two different forms of investments, as well as a certain lag between each other. Empirically, the direct returns follow their indirect returns by a period, which means a year in Switzerland. These findings are totally congruent with the results of other real estate papers examining these relationships for other markets[61]. Also there, unsmoothing significantly improves correlation, whereas unlevering does not. In much more advanced markets as the US or UK[62], direct real estate is measured on a quarterly or even on a monthly basis, which reduces the lag.

The characteristic of the listed markets to lead the direct markets can also be explained by the inefficient transfer of information[63] to the direct markets. The stronger the delaying factors to the direct markets are, the longer the gap between the market returns is.

Empirically, we observe that while the listed returns are directionally accurate, they tend to overstate reported direct market moves[64]. This can be explained by the influence the stock market has on indirect real estate. Indirect Real Estate is seen as an alternative to equity and fixed income on the financial markets and is influenced by their movements in the short term. In mid- to long- term, they correlate more with the direct real estate than with equity.

[61] Sebastian, Schätz (2009), p. 2
[62] Allen, Gysens, Carroll, Riemer (2009) p. 2
[63] Wang, Lizieri, Matysiak (1997) p. 267
[64] Gyourko, Keim (1992), p. 460

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11 APPENDIX

Year	Index SXI Real Estate Funds TR	Index SXI Real Estate Funds TR unlevered	Index SXI Real Estate Funds total return	Index SXI unlevered net of tax	IPD CH	IPD yields	IPD yield unsmoothed	Index IPD CH unsmoothed
2001	145.39	145.39			1.0000			1.0000
2002	156.63	153.91	7.73%	5.86%	1.0556	5.56%		1.0524
2003	176.55	171.82	12.72%	9.70%	1.1099	5.15%	4.52%	1.1000
2004	188.29	183.76	6.65%	4.08%	1.1665	5.09%	5.02%	1.1551
2005	200.02	195.21	6.23%	3.68%	1.2273	5.22%	5.40%	1.2175
2006	206.51	205.01	3.24%	2.50%	1.3001	5.93%	7.00%	1.3028
2007	199.45	201.08	-3.42%	-2.63%	1.3924	7.10%	8.85%	1.4181
2008	200.51	200.27	0.53%	0.41%	1.4773	6.10%	4.60%	1.4833
mean			4.81%	3.37%		5.74%	5.90%	
mean for robust correlation			4.88%			5.58%		
Standard deviation			0.0485	0.0363		0.0066	0.0156	
Standard deviation robust correlation			0.0263			0.0039		

Table I: Indices of macro view

Name	Index Real Estate Fund Interswiss	Index Interswiss unlevered net tax index	Interswiss yield	interswiss yields unlevered net of tax	Agio Schweizer Immobilienfonds	Agio CS REF Interswiss	Agio Schroder Immoplus	Index Interswiss unlevered net tax index	Index Schroder Immoplus TR	Index Schroder Immoplus unlevered net of tax
31.12.01	186.25	187.17			6.76%	7.07%	1.12%	187.17		
31.01.02	187.6	188.30	0.72%	0.49%	8.13%	7.38%	1.02%	188.30	105.92	105.73
28.02.02	188.68	189.17	0.58%	0.37%	8.35%	7.54%	0.77%	189.17	106.09	105.95
29.03.02	189.49	188.70	0.43%	0.26%	10.20%	7.54%	1.32%	188.70	107.1	106.73
30.04.02	188.68	193.64	-0.43%	-0.42%	8.68%	6.64%	1.38%	193.64	107.61	107.37
31.05.02	195.15	197.97	3.43%	2.63%	10.59%	9.83%	1.92%	197.97	108.62	108.25
28.06.02	198.92	201.74	1.93%	1.44%	11.87%	11.49%	2.45%	201.74	109.64	109.26
31.07.02	202.7	201.90	1.90%	1.42%	12.63%	13.13%	1.89%	201.90	109.47	109.42
30.08.02	201.89	200.45	-0.40%	-0.40%	12.81%	12.21%	2.10%	200.45	110.14	109.86
30.09.02	200.27	203.08	-0.80%	-0.71%	12.24%	10.86%	2.63%	203.08	111.16	110.78
31.10.02	204.04	201.97	1.88%	1.41%	15.21%	12.48%	4.09%	201.97	113.18	112.53
29.11.02	201.62	206.85	-1.19%	-1.02%	11.51%	11.18%	4.29%	206.85	114.37	113.94
31.12.02	208.45	210.87	3.39%	2.59%	11.98%	15.13%	6.58%	210.87	117.25	116.36
31.01.03	211.83	216.60	1.62%	1.16%	15.54%	16.52%	6.93%	216.60	118.11	117.84
28.02.03	218.31	217.53	3.06%	2.25%	18.16%	19.57%	7.59%	217.53	119.31	118.97
31.03.03	217.46	214.76	-0.39%	-0.36%	17.28%	18.59%	8.55%	214.76	120.85	120.44
30.04.03	214.08	219.06	-1.55%	-1.24%	15.49%	16.29%	9.19%	219.06	122.05	121.71
30.05.03	220.84	217.29	3.16%	2.32%	18.61%	19.45%	7.72%	217.29	123.49	123.10
30.06.03	216.34	214.49	-2.04%	-1.61%	16.69%	16.51%	9.12%	214.49	125.59	125.06
31.07.03	214.08	214.80	-1.04%	-0.85%	16.44%	14.85%	9.45%	214.80	126.46	126.18
29.08.03	215.21	215.49	0.53%	0.33%	17.28%	14.96%	10.53%	215.49	128.21	127.75
30.09.03	215.77	220.11	0.26%	0.13%	15.60%	14.78%	11.15%	220.11	129.44	129.09
31.10.03	221.69	222.18	2.74%	2.01%	18.37%	17.47%	12.97%	222.18	132.06	131.41
28.11.03	222.53	226.47	0.38%	0.22%	20.04%	18.60%	16.49%	226.47	136.09	135.14
31.12.03	227.93	232.91	2.43%	1.77%	20.53%	22.00%	18.10%	232.91	138.2	137.65
30.01.04	234.68	234.75	2.96%	2.18%	22.71%	25.09%	19.91%	234.75	140.86	140.20
27.02.04	234.97	230.36	0.12%	0.03%	21.79%	24.70%	18.70%	230.36	139.97	140.07
31.03.04	229.1	224.50	-2.50%	-1.96%	21.56%	21.07%	16.15%	224.50	137.49	137.93
30.04.04	223.23	224.87	-2.56%	-2.01%	17.28%	17.47%	14.07%	224.87	135.54	135.87
31.05.04	225.58	222.31	1.05%	0.74%	17.85%	18.20%	13.49%	222.31	135.36	135.31

30.06.04	221.46	221.77	-1.83%	-1.45%	17.49%	15.57%	13.65%	221.77	136.07	135.83
30.07.04	222.05	223.91	0.27%	0.14%	17.38%	15.39%	12.34%	223.91	135.01	135.15
31.08.04	224.69	227.01	1.19%	0.84%	17.23%	16.28%	12.80%	227.01	136.07	135.76
30.09.04	227.93	233.13	1.44%	1.03%	17.30%	17.46%	12.67%	233.13	136.43	136.26
29.10.04	234.97	233.13	3.09%	2.28%	20.43%	20.60%	14.22%	233.13	138.82	138.22
30.11.04	232.74	241.71	-0.95%	-0.78%	20.26%	18.96%	14.45%	241.71	139.61	139.35
31.12.04	244.76	249.16	5.16%	3.86%	22.05%	25.60%	18.24%	249.16	141.74	141.20
31.01.05	250.87	245.76	2.50%	1.80%	25.31%	28.20%	19.67%	245.76	144.04	143.45
28.02.05	244.14	245.83	-2.68%	-2.04%	20.91%	24.22%	17.13%	245.83	141.56	141.99
31.03.05	246.59	246.82	1.00%	0.69%	23.38%	24.94%	17.23%	246.82	142.27	142.02
29.04.05	247.08	255.20	0.20%	0.09%	23.65%	24.66%	17.20%	255.20	142.8	142.59
31.05.05	258.22	258.09	4.51%	3.29%	25.94%	29.73%	18.46%	258.09	144.93	144.38
30.06.05	258.22	256.81	0.00%	-0.05%	25.59%	29.19%	19.43%	256.81	144.93	144.83
29.07.05	256.5	256.55	-0.67%	-0.55%	27.51%	27.80%	22.97%	256.55	146.7	146.22
31.08.05	256.75	254.99	0.10%	0.02%	25.62%	27.38%	20.62%	254.99	151.66	150.50
30.09.05	254.55	255.05	-0.86%	-0.69%	24.96%	25.77%	19.71%	255.05	149.36	149.75
31.10.05	255.4	250.83	0.33%	0.20%	23.59%	25.68%	17.25%	250.83	148.83	148.84
30.11.05	249.41	256.98	-2.35%	-1.79%	19.48%	22.22%	18.15%	256.98	146.35	146.78
30.12.05	259.81	258.39	4.17%	3.04%	22.80%	25.13%	21.00%	258.39	146.35	146.25
31.01.06	258.03	263.84	-0.69%	-0.55%	22.24%	23.91%	19.94%	263.84	149.72	148.90
28.02.06	266.31	260.86	3.21%	2.25%	25.86%	27.35%	21.45%	260.86	148.74	148.96
31.03.06	258.92	261.99	-2.77%	-2.05%	24.43%	22.79%	20.02%	261.99	151.16	150.28
28.04.06	263.38	259.39	1.72%	1.18%	24.36%	24.40%	21.02%	259.39	150.44	150.57
31.05.06	258.03	254.69	-2.03%	-1.51%	23.98%	21.37%	21.16%	254.69	151.69	151.19
30.06.06	253.57	253.80	-1.73%	-1.30%	19.95%	18.78%	17.91%	253.80	152.95	152.45
31.07.06	254.08	253.02	0.20%	0.09%	20.15%	18.54%	16.37%	253.02	149.36	150.42
31.08.06	252.8	253.67	-0.50%	-0.42%	20.00%	17.47%	16.67%	253.67	147.93	148.29
29.09.06	254.2	253.61	0.55%	0.34%	18.56%	17.64%	14.86%	253.61	148.83	148.44
31.10.06	253.57	255.26	-0.25%	-0.23%	17.88%	16.88%	14.46%	255.26	147.03	147.51
30.11.06	256.11	260.74	1.00%	0.67%	18.23%	17.58%	15.74%	260.74	147.03	146.93
29.12.06	262.74	262.35	2.59%	1.81%	20.78%	20.42%	20.45%	262.35	149.18	148.39
31.01.07	262.42	264.54	-0.12%	-0.15%	23.62%	18.59%	21.18%	264.54	154.94	152.99
28.02.07	265.37	274.48	1.12%	0.81%	22.63%	18.79%	22.46%	274.48	156.48	156.02
30.03.07	277.43	277.28	4.54%	3.43%	25.36%	23.69%	23.38%	277.28	158.75	158.13
30.04.07	277.43	276.25	0.00%	-0.05%	23.47%	23.18%	21.38%	276.25	160.56	160.04

31.05.07	276.09	272.75	-0.48%	-0.43%	22.74%	22.09%	19.60%	272.75	158.57	158.91
29.06.07	271.93	274.46	-1.51%	-1.21%	20.07%	19.77%	16.83%	274.46	159.07	158.85
31.07.07	275.42	274.76	1.28%	0.93%	19.28%	20.81%	16.53%	274.76	158.79	158.75
31.08.07	274.75	275.21	-0.24%	-0.24%	18.45%	20.04%	15.29%	275.21	158.98	158.83
28.09.07	275.55	267.59	0.29%	0.17%	16.64%	19.91%	15.39%	267.59	157.87	158.01
31.10.07	265.37	257.61	-3.69%	-2.89%	14.77%	15.02%	13.37%	257.61	158.61	158.33
30.11.07	255.45	261.20	-3.74%	-2.92%	11.48%	10.28%	10.03%	261.20	156.4	156.79
31.12.07	263.13	262.21	3.01%	2.25%	8.93%	10.17%	8.52%	262.21	152.35	153.16
31.01.08	262.15	271.07	-0.37%	-0.35%	9.37%	9.32%	10.27%	271.07	155.89	154.98
29.02.08	273.74	272.49	4.42%	3.40%	12.27%	13.70%	14.02%	272.49	158.88	158.16
31.03.08	272.35	276.56	-0.51%	-0.46%	12.32%	12.68%	14.27%	276.56	164.85	163.50
30.04.08	277.93	279.96	2.05%	1.54%	11.76%	14.54%	13.75%	279.96	165.79	165.50
30.05.08	280.73	278.38	1.01%	0.73%	13.21%	15.23%	15.16%	278.38	165.6	165.55
30.06.08	277.93	279.96	-1.00%	-0.84%	12.67%	13.64%	15.66%	279.96	168.21	167.57
31.07.08	280.73	279.47	1.01%	0.73%	11.29%	14.34%	14.88%	279.47	169.52	169.15
29.08.08	279.33	278.95	-0.50%	-0.45%	10.33%	13.33%	13.42%	278.95	168.96	168.98
30.09.08	279.05	256.27	-0.10%	-0.14%	11.31%	12.78%	10.33%	256.27	167.37	167.61
31.10.08	250.14	251.52	-10.36%	-8.16%	4.37%	0.71%	0.53%	251.52	163.36	164.11
28.11.08	252.09	264.83	0.78%	0.55%	4.78%	4.62%	-3.57%	264.83	149.36	152.22
31.12.08	268.56	268.22	6.53%	5.05%	4.83%	6.11%	-3.73%	268.22	146.56	147.07
30.01.09	268.27	263.98	-0.11%	-0.13%	8.53%	5.58%	-1.86%	263.98	146.9	146.75
27.02.09	262.72	262.27	-2.07%	-1.60%	8.56%	2.99%	-4.71%	262.27	150.31	149.62
31.03.09	262.29	267.43	-0.16%	-0.17%	9.60%	2.42%	-6.68%	267.43	146.52	147.14
30.04.09	269.29	284.74	2.67%	1.96%	10.97%	4.75%	-7.90%	284.74	144.06	144.44
29.05.09	290.02	291.09	7.70%	5.74%	13.57%	11.97%	-0.82%	291.09	142.73	142.91
30.06.09	291.62	291.70	0.55%	0.37%	13.35%	12.16%	1.35%	291.70	154.29	152.12
31.07.09	291.91	296.27	0.10%	0.03%	13.84%	11.84%	1.50%	296.27	158.27	157.47
31.08.09	297.9	299.62	2.05%	1.49%	15.04%	13.70%	4.19%	299.62	159.12	158.89
30.09.09	300.38	304.30	0.83%	0.58%	17.28%	14.21%	5.59%	304.30	163.96	163.00
30.10.09	305.78	309.48	1.80%	1.30%	18.03%	15.83%	7.58%	309.48	166.8	166.21
30.11.09	310.89	326.58	1.67%	1.21%	16.74%	15.99%	6.12%	326.58	170.59	169.82
31.12.09	331.97	331.97	6.78%	5.05%	15.99%	24.36%	12.67%	331.97	168.7	168.96

Table II: Indices of micro view

12 Ehrenwörtliche Erklärung

Ich erkläre hiermit, dass ich die vorliegende Masterthesis:

"Correlations between direct and indirect real estate investments in Switzerland;

A macro and micro empirical analysis of real estate as an asset class"

selbst angefertigt habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht.

Die Arbeit wurde bisher keiner anderen Prüfungsbehörde vorgelegt und auch nicht veröffentlicht.

Zürich, den *13. 08. 2010*

Unterschrift