Inflation Hedging Abilities of Indirect Real Estate Investments in Switzerland

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Introduction

Real Estate investments have been discussed for a long time in both academic literature and practice. Intuitively, many people assume that real estate returns may have a high correlation with inflation (Fama and Schwert, 1977: 4; Anson, 2009: 78). They therefore expect real estate investments to provide inflation hedging abilities (Wohlwend and Goller, 2011; Marti, Meier, and Davidson, 2014: 12). Accordingly, most of the past research on real estate has focused on the diversification effects of real estate in portfolios of stocks and bonds and on the inflation hedging abilities of real estate.

There are different ways to invest in real estate (Garay and Ter Horst, 2009: 90): (1) Equity: One can invest in the equity part of real estate by buying real estate mutual funds, like US-American Real Estate Investment Trusts (REITs)[1], or by acquiring real estate physically. The first is considered as an indirect, public, securitized, or financial investment. The latter is said to be a direct, physical, or private investment. (2) Debt: It is also possible to invest in the debt part of real estate. This is normally done in a securitized form, for example, with mortgage-backed securities (MBS). This paper, however, only considers indirect investments in the equity part of real estate.[2]

There are only a limited number of publications considering the situation in Switzerland and this research, which considers Switzerland particularly, is often not very recent. This is problematic because inflation hedging abilities could change over time as it was shown by the study of Moigne and Viveiros (2008: 282). In addition, investigations have often focused on institutional rather than individual investors, thereby analyzing effects of direct real estate, which is often not suitable as an investment for a private person.

This paper examines inflation hedging abilities of Swiss indirect real estate investments. It only considers indirect investment solutions[3] that are realizable for an individual investor and therefore offers important insights on how real estate protects private investors against inflation. As a proxy for indirect investment solutions, we use the indices of real estate mutual funds.

In this paper, we provide a new evaluation of the research question for Switzerland. As shown in the study of Moigne and Viveiros (2008: 282), the relationship between real estate returns and inflation can change over time. Their paper shows that in Canada, this change was due to the decrease in interest rates. In Switzerland, there was a structural interruption in the real estate market in the early 1990's, when a real estate bubble burst (Alvarez, 2013: 6). Therefore, it makes sense to conduct new research on the situation in Switzerland using more recent financial market data.

The paper is organized as follows: After the introduction we present the previous research on this topic. Afterwards follows a discussion of the applied research methodology and the data used. In the subsequent part, the results of the paper are presented. This is followed by a discussion of the findings and a conclusion.

Literature Review and Previous Research

This section summarizes the results of previous research regarding the inflation hedging abilities of real estate.

The inflation hedging abilities of real estate have interested researchers and practitioners since the 1970s. Although a strong relationship between inflation and real estate returns may sound intuitive to some people (Fama and Schwert, 1977: 4), there are some valid reasons to question this relationship. For instance, if a building were leased at a fixed rent, which does not adjust to inflation, the value of this building would decline if inflation increases (Goetzmann and Valaitis, 2006: 2). The two main reasons for an inflation hedge are that rental and lease payments are adjusted regularly to inflation and the capital shift from stock and bonds in times of inflation into real estate, which leads to price appreciations (Anson, 2009: 79). Graff and Cashden (1990) have therefore postulated a decomposition of real estate returns into income returns and capital appreciation returns. The basic idea is that capital appreciation returns provide a good inflation hedge, as opposed to income returns, where this hedge is questionable.

International Evidence

Two of the first researchers who examined the inflation hedging abilities of real estate were Fama and Schwert (1977). They found evidence that real estate provides a hedge against unexpected inflation. However, the coefficient for unexpected inflation was significantly lower than one, thus rejecting the hypothesis of a complete hedge against unexpected inflation (Fama and Schwert, 1977: 130). The estimate for expected inflation was not significantly different from one, which does not reject the proposition that all assets should be a hedge against expected inflation (Fama and Schwert, 1977: 127). The study was conducted using data ranging from 1953 to 1971. The results changed only slightly if the researchers used quarterly or semiannual instead of monthly data.

Miles and Mahoney (1997) used the Fama and Schwert framework in their research for the United States. They concluded that direct real estate is a complete hedge against expected inflation, but that it is only an incomplete hedge against unexpected inflation when using quarterly data. This study thus confirms the results of the research conducted by Fama and Schwert (1977).

Hartzell, Hekman, and Miles (1987: 626) also used the Fama and Schwert approach and found that direct real estate provides a hedge against expected inflation. However, they also found that direct real estate is a complete hedge against unexpected inflation. This result is therefore contradictory to the result of the Fama and Schwert study. That of Hartzell et al. (1987: 618) used quarterly holding period returns from over 300 properties.

Moigne and Viveiros (2008: 275) researched Canadian direct real estate investments and found that real estate acts as a complete hedge against expected inflation and even "overhedge" unexpected inflation ($\gamma = 2.04$). This is a huge discrepancy to the results for the US, where real estate seems to provide only an incomplete hedge against unexpected inflation. However, Moigne and Viveiros (2008: 282) found that the inflation hedging ability has disappeared since the mid-1980s when the Canadian inflation rate decreased significantly.

Research for Singapore has found no significant inflation hedge for indirect real estate investments but has found an inflation hedging ability for shop and industrial property (Sing and Low, 2000: 380).

All of the above-mentioned studies applied the approach developed by Fama and Schwert (1977). However, it should be noted that there is also some criticism to this approach. Hence, other authors have used different techniques to research the topic.

Chaudhry, Myer, and Webb (1999) used co-integration techniques for data of the United States. They concluded that, "… there is an underlying factor that links the financial-asset [sic] and real-assets markets, at least in the long run. When CPI is included in the three systems, the number of common factors increases to two, implying that inflation does play an important role in creating a linkage between these time series." (Chaudhry et al., 1999: 347). Furthermore, they found that all of the tested financial and real estate returns are non-stationary. Therefore, they argue that conventional statistical methods like the Fama and Schwert framework should not be applied (Chaudhry et al., 1999: 342).

In Hong Kong, evidence in favor of the inflation hedge was found with the method of Fama and Schwert, but not with a co-integration method (Ganesan and Chiang, 1998: 65). This indicates that there might be a short run relationship between inflation and real estate returns, but it also indicates that this relationship may not be stable in the long run. Therefore, the regression of the Fama and Schwert framework could be spurious (Ganesan and Chiang, 1998: 65).

Hardin, Jiang and Wu (2010) analyzed the development of equity REITs dividend yield relative to the expected inflation. Hardin et al. (2010) came to the conclusion that a certain inflation protection exists but is undermined due to the inflation illusion perceived by investors. The results additionally provide an alternative explanation as to why the yields on REITs often negatively correlated with expected inflation.

The study of Demary and Voigtlander (2009) focuses on the inflation protection of direct and indirect real estate investments.

REITs cannot protect investors from general inflation. As well as other stocks, they offer no effective protection from inflation, and analysis of yields and inflation rates show negative correlations. A rising price level thus adversely affects the actual returns on this investment. According to Demary and Voigtlander (2009), this is explained by the fact that investors adjust their expectations due to inflation and the resulting possible deterioration of the macroeconomic environment.

Demary and Voigtlander (2009) and Giljohann-Farkas and Pfleiderer (2008) found that for direct real estate investments a positive correlation between consumer price index and real estate index confirms better inflation protection.

The analysis of Simpson, Ramchander and Webb (2007) arrived at similar conclusions for REITs as inflation protection as did Demary and Voigtlander (2009). Simpson et al. (2007) concluded that there is an asymmetric development of yields from REITs and the inflation rate, while not explicitly postulating a negative correlation.

The studies of Adrangi, Chatrath and Raffiee (2004), Glascock, Lu and So (2002), Stevenson (2001) and Chan, Hendershott and Sanders (1990) conclude from the analyses of the yields of REITs that no effective protection against inflation can be explained. The investigation of an unexpected inflation component suggests, however, that a link between monetary policy and real estate prices does exist.

From this perspective Hoesli, Lizieri and MacGregor (2008) also consider the inflation protection properties of direct and indirect real estate investments, but they cannot explain a causal link between the development of the inflation rate and yields on REITs.

Maurer and Sebastian (2002), on the other hand, state that indirect real estate investments do provide inflation protection due to the excess returns, whereas the studies of both Maurer and Sebastian (2002) and Lu and So (2001) come to the result that the analysis of the development of yields on REITs and other underlying macroeconomic factors such as monetary developments are more revealing. Lu and So (2001) concluded further that the future of inflation could derive from the yields on REITs. This would confirm the delay effect, where the inflation expectation in the market prices of REITs is anticipated, and therefore, if investors are correct, inflation only occurs after a certain delay.

Although Chatrath and Liang (1998) determined no connection between REITs yields and inflation in the short term, however, a certain link could be detected in the long term.

Generally, real estate has its own risk and return profile. Nevertheless, the public stock and bond markets influence the performance of the real estate market (Anson, 2012: 59), especially indirect real estate investments (Garay and Stevenson, 2009: 242; Wohlwend and Goller, 2011; Marti, Meier, and Davidson, 2014: 17).

In summary, previous results cannot confirm a direct causal relationship between the inflation rate and the yield of indirect real estate investments. The studies of Hoesli et al. (1997) and Hamelink, Hoesli und MacGregor (1997) also join this core conclusion. In the long term, the total return (price change and distribution) of indirect real estate can compensate for a loss of purchasing power, but in the short term no hedge against inflation exists.

Evidence for Switzerland

There are only few papers that analyze the situation in Switzerland. Most of the research for Switzerland was conducted in the 1990s. One of the first papers was written by Anderson and Hoesli (1991), who found that Swiss stocks, bonds and real estate mutual funds protected investors from inflation in Switzerland in the period between 1978 and 1989. The research of Hamelink and Hoesli (1996: 47) for Switzerland was conducted with direct and indirect real estate investments using the Fama and Schwert approach. However, they did not find any inflation hedging abilities - neither for direct real estate investments nor for indirect investments.

Hoesli (1994) focused on real estate mutual funds in Switzerland. The paper analyzes the inflation hedging ability using monthly, quarterly, annual and five-year data. For all time intervals no significant inflation hedging ability was found. However, the β coefficient, in this study being the coefficient for total inflation, is 0.463 for five-year data and the t-statistic is 1.557. This indicates that real estate funds may provide an inflation hedge in the long run (Hoesli, 1994: 56).[4] All coefficients for expected and unexpected inflation are as well not significantly different from zero (Hoesli, 1994: 57).

Liu, Hartzell, and Hoesli (1997) conducted international research on real estate mutual funds. Although it is known that US Real Estate Mutual Funds (REITs) do not provide inflation hedging ability and indeed behave more like stocks than like real estate, Mengden and Hartzell (1986 in: Liu et al., 1997) argue that this might not be true for other countries. For example, Swiss real estate mutual funds are different from US-REITs in that the Swiss units can be redeemed at the intrinsic value (Hoesli, 1994: 52), whereas US-REITs have a closed form structure (Liu et al., 1997: 196). One would therefore expect Swiss real estate mutual funds to behave differently than US-REITs. However, the study does not find any inflation hedging ability in Switzerland (Liu et al., 1997: 208).

Wohlwend and Goller (2011) conducted a comprehensive study on the inflation hedging abilities of different asset classes. They found that, with a high probability, there is no relationship between real estate and inflation in Switzerland. None of the studied asset classes offer complete inflation protection in the long run (Wohlwend and Goller, 2013: 21).

To sum up, it can be stated that direct real estate was found to provide inflation hedging abilities in most countries around the world but not in Switzerland. Internationally, direct real estate seems to provide a good hedge against expected inflation and at least a partial hedge against unexpected inflation. This is not the case for Switzerland where real estate does not seem to provide any hedge against inflation. Indirect real estate investments seem not to provide protection against inflation, no matter whether the real estate funds have a closed form or an open form structure. Exhibit 1 pictures the stylized results of previous research on the inflation hedging abilities of real estate (see also Anson, 2009: 102).

	Direct investments	Indirect investments
International	Yes	No
Switzerland	No	Probably not (focus of the paper)

Exhibit 1: Inflation Hedging Abilities According to Previous Research
Source: Authors' Calculations

Research Methodology

In this section we discuss the Fama and Schwert approach to determine the inflation hedging abilities of real estate investments. Previous studies show that this approach has been frequently used by numerous other authors (e.g. Hamelink and Hoesli, 1996; Miles and Mahoney, 1997) and is still a widely accepted approach.[5]

The Fama and Schwert Approach

Fama and Schwert (1977) developed a common approach to determine inflation hedging abilities. In accordance with Fisher (1930) they argued that the expected nominal return of an asset is the sum of the expected real return of the asset and the expected inflation rate (see also Wohlwend and Goller, 2011). Therefore, expected inflation is priced in for all assets and a complete hedge against expected inflation should be provided. Hence, it is necessary to make a distinction between unexpected and expected inflation. Fama and Schwert (1977) therefore analyzed the inflation hedging abilities with a two-factor model. The asset return is the dependent variable and the expected and unexpected inflation are the independent variables.

$$R_{it} = \alpha_i + \beta_i(E(\pi_t)) + \gamma_i(\pi_t - E(\pi_t)) + \varepsilon_{it} \qquad (E1)$$

Where:
R_{it} is the return of asset i in period t
$E(\pi_t)$ is the expected inflation for period t
$\pi_t - E(\pi_t)$ is the unexpected inflation for period t
ε_{it} is an error term, residual effects that are not explained by the data

If $\beta = 1$, an asset is said to be a complete hedge against expected inflation. An asset is called a complete hedge against unexpected inflation if $\gamma = 1$. If $\beta = \gamma = 1$, then an asset is said to provide a complete hedge against inflation (Fama and Schwert, 1977: 117). One would expect all assets to be a complete hedge against expected inflation ($\beta = 1$) but only some assets to provide a complete, if any, hedge against unexpected inflation ($\gamma = 1$) (Fama and Schwert, 1977: 117).

Further Development of the Fama and Schwert Approach

However, the approach introduced by Fama and Schwert can also be criticized. The main difficulty of this approach is to distinguish between expected and unexpected inflation. Fama and Schwert solved this problem by using treasury bills as a proxy for expected inflation. The expected inflation equals the T-bill yield minus the real return (i.e. the real interest rate; Miles and Mahoney, 1997: 32). This made it necessary to assume constant real interest rates, because one can otherwise not assume that a change in the T-bill yield was due to a change in inflation expectations (see also Wohlwend and Goller, 2011). This assumption was true for the period that Fama and Schwert analyzed, but the assumption may not hold nowadays (Ganesan and Chiang, 1998: 58). In later papers, other methodologies have therefore been developed to find another measure for expected inflation.

For instance, Fama and Gibbons (1982) and Hartzell, Hekman, and Miles (1987) apply moving-average processes to estimate expected inflation. Hamelink and Hoesli (1996) researched the topic for Switzerland. They also used the model of Fama and Schwert, but they estimated expected inflation using four different ways.

1. First, they follow Gültekin (1983) by assuming that expectations are perfect. Hence, expected inflation equals the actual inflation and there is no unexpected inflation. This reduces the model of Fama and Schwert to a simple one-factor model in which actual inflation is the only independent variable (Hamelink and Hoesli, 1996: 36):

$$R_{it} = \alpha_i + \beta_i(\pi_t) + \varepsilon_{it} \qquad (E2)$$

Where:
R_{it} is the return of asset i in period t
π_t is the actual inflation for period t
ε_{it} is an error term, residual effects that are not explained by the data

2. The second approach used to proxy expected inflation by Hamelink and Hoesli (1996: 36) is a linear regression model, which specifies the expected inflation rate at time t as a linear function of the inflation rate at time t-1. This model is:

$$\pi_t = \alpha + \beta(\pi_{t-1}) + \varepsilon_t \qquad (E3)$$

Where:
π_t is the expected inflation for period t
π_{t-1} is the actual inflation for period t-1
ε_t is an error term, residual effects that are not explained by the data

3. The third method is a qualitative threshold autoregressive conditional heteroscedasticity (QTARCH) model, introduced by Gouriéroux and Monfort (1992). This model leads to a conditional mean and a conditional variance, which are endogenous stepwise functions (Hamelink and Hoesli, 1996: 36).

4. The fourth approach is based on an ARCH in mean (ARCH-M) model. In this model, developed by Engle, Lilien and Robins (1987), conditional expected inflation is a function of the conditional variance of the period before. This method is therefore different from the second and the third methods because the expected inflation is derived from the variance of the period before, and not the inflation rate of the period before (Hamelink and Hoesli, 1996: 37).

Methodology of the Current Paper

To keep it simple, for our analysis of the inflation hedging abilities of real estate we have also applied the approach proposed by Fama and Schwert (1977). We decomposed the actual inflation in an expected and an unexpected part with two different methods. (1) We assume for the decomposition that expectations are perfect, just as Gültekin (1983) did. This reduces the model of Fama and Schwert to the equation E2, which was presented above. (2) Furthermore, we apply in this paper the second method proposed by Hamelink and Hoesli (1996: 36). The decomposition is conducted by inferring the expected inflation at time t from the actual inflation at time t-1. This paper uses the formula that was presented above in equation E3.

Data

Biases in Real Estate Performance Data

Real estate is often considered as an illiquid asset class (Anson, 2012: 45; Marti, Meier, and Davidson, 2014: 12): On the one hand, the transaction size is high, but on the other hand, real estate objects are not publicly traded and trading is infrequent. The "semi strong" notion of market efficiency (all public information is included in the price) does not exist, because transactions are regularly private. Without public price information available, other assessment methods are necessary.

But appraisal based valuation methods tend to lead to an underestimation ("smoothing") of the volatility of real estate investments (Anson, 2009: 84; Marti, Meier, and Davidson, 2014: 12). This could also be a problem not only for the measurement of the inflation hedge ability, but in the level of index construction too where different biases can occur (Garay and Stevenson, 2009: 229). We often see a difference between the net asset value of the mutual fund and its stock market price for indirect real estate investments products (Garay and Stevenson, 2009: 237).[6]

Past financial market data are existent as time series and tend to affect current data. Hence, autocorrelation is a frequent problem in real estate time series. Autocorrelation leads to problems in the statistical analysis of the data. As a result, or to counter this, correction procedures need to be applied (Marti, Meier, and Davidson, 2014: 16).

We are aware of the difficulties of the performance measurement for real estate investments. Consequently, we assume for this study (1) that the investor can realize the performance of the investment fund and neglect any valuation issues within the fund (realistic). (2) Further, we assume no transaction costs for the investor (unrealistic). (3) In addition, we assume that the indices of the empirical analysis are investable for private investors (not always true).

Data sources and description

The research was conducted with quarterly data using the inflation rates and real estate fund returns during a 20-year time span from 1995q1 (SWIIT, RUEDIF) and 1997q1 (WUPIXF) until 2015q2.

The study uses log-changes in the consumer price index (CPI) of Switzerland as a proxy for inflation (data source: Swiss Federal Statistical Office). The CPI represents the price of a typical basket of goods consumed by a private person. Since the study focuses on individual investors, the CPI is a better proxy for inflation than, for example, the GDP-deflator (see also Wohlwend and Goller, 2011).

During the whole time period of the research interest rates and inflation rates in Switzerland were extremely low and fluctuated around zero. Switzerland and the Swiss Franc have acted as safe havens in recent years, especially since the start of the crisis in 2007. Therefore, the real estate markets have faced price appreciations due to huge capital inflows and the "search for yield".

In Switzerland, we can distinguish between four groups of real estate indices (Marti, Meier, and Davidson, 2014: 12): (1) stock market based real estate indices[7], (2) indices by independent real estate specialists, (3) real estate indices based on selling offers, and (4) indices based on transaction data. Indices of Group 1 are suitable for our purposes. These are constructed from the pricing of real estate stock corporations and real estate mutual funds.

As a proxy for the indirect real estate returns we used three stock market based real estate indices (group (1), see above): SWIIT: SXI Real Estate Funds Index, RUEDIF: DB RUEDBLASS IF Index, and WUPIXF: Wüest & Partner AG Index für Immobilienfonds (data source: SIX Group, Rüd Blass, Wüest & Partner).

As an example, the SXI Real Estate index (an umbrella structure) contains real estate funds and real estate companies; the SXI Real Estate Funds index (a sub structure) contains only real estate funds (Meier, 2011: 8). It can be assumed that real estate stocks behave more like stocks than like real estate due to their closed form structure. Hence, this study uses real estate fund indexes to track indirect real estate performance.

As performance data, we applied quarterly log-changes of total return (price changes and distributions) index values.

Results

In this section we discuss the findings of our research regarding the inflation hedging abilities.

The inflation hedging abilities of Swiss real estate mutual funds were tested using the approach of Fama and Schwert (1977). The decomposition of actual inflation in an expected and an unexpected part was done using two different methods. (1) Firstly, by assuming that expectations are perfect. (2) Secondly, by inferring the expected inflation at period t from the actual inflation at period t-1.

(1) Assumption that expectations are perfect

First, the calculation was carried out under the assumption that expectations are perfect using equation E2:

$$R_{it} = \alpha_i + \beta_i(\pi_t) + \varepsilon_{it} \qquad (E2)$$

This leads to the results on Exhibit 3.

The negative sign of the beta coefficient of all index returns for actual inflation would actually suggest that Swiss indirect real estate acts as a "reverse" hedge against inflation. However, the standard error of the regression is high in order to state that with certainty. All coefficients are not significant at standard levels. The values for R-squared are extremely low. This is an indicator of poor fit of our model.

Variable	Obs	Mean	Std. Dev.	Min	Max
CPI	83	94.81807	4.195792	86.7	100.7
SWIIT_ret	82	0.0146025	0.03309	-0.0783483	0.094881
RUEDIF_ret	82	0.0152531	0.0346421	-0.0846643	0.1014157
WUPIXF_ret	74	0.0139985	0.0323943	-0.0673932	0.0791508

SWIIT: SXI Real Estate Funds Index
universe: all at the SIX Swiss Exchange listed real estate funds, which invest ¾ of the real estate values in the Switzerland, currently 26 positions

RUEDIF: DB RUEDBLASS IF Index
universe: maximum 10 Swiss real estate funds

WUPIXF: Wüest & Partner AG Index für Immobilienfonds
universe: in Switzerland listed real estate funds, currently 24 positions

Exhibit 2: Summary Statistics Consumer Price index and Real Estate Indices
Source: Authors' Calculations

Variables E2	SWIIT_ret	RUEDIF_ret	WUPIXF_ret
INF	-0.806	-1.001	-0.929
	(0.643)	(0.670)	(0.658)
Constant	0.0158***	0.0168***	0.0152***
	(0.00377)	(0.00394)	(0.00384)
Observations	82	82	74
JB chi2	0.1791	0.7923	1.289
JB Prob > chi2	0.9143	0. 6729	0.5248
BP chi2	0.02	0.23	0.37
BP Prob > chi2	0.8904	0.6345	0.5415
R-squared	0.019	0.027	0.027

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
JB: Jarque-Bera test for normality (H0: normality). We cannot reject the hypothesis that our returns are normally distributed.
BP: Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (H0: constant variance). We cannot reject the hypothesis that our returns have a constant variance.

Exhibit 3: Regression Results E2
Source: Authors' Calculations

Variables E3	INF	
INF_L1	-0.315***	(0.102)
Constant	0.00185***	(0.000602)
Observations	81	
R-squared	0.108	

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Exhibit 4: Regression Results E3
Source: Authors' Calculations

(2) Inferring expected inflation from past actual inflation rates

As a second approach, the expected inflation at time t is inferred from the actual inflation at time t-1. This is done by a regression analysis as presented in equation E3 following Hamelink and Hoesli (1996: 36).

$$\pi_t = \alpha + \beta(\pi_{t-1}) + \varepsilon_t \qquad (E3)$$

The regression leads to the outcome illustrated in Exhibit 4.

The lagged inflation INF_L1 and the constant are both highly significant and the R-squared of the regression is 0.108. The negativity of the beta coefficient for INF_L1 is somewhat surprising. This indicates that a higher inflation rate in the quarter t-1 is likely to lead to a lower inflation rate in quarter t. Hamelink and Hoesli (1996: 40) found a highly significant positive beta, but for yearly data. In addition, bimonthly data for the US seems to indicate that inflation normally has a positive autocorrelation (Bils, Klenow, and Malin, 2012: 2806). The negative coefficient found in our study may be due to the extraordinary economic environment after the financial crisis or due to seasonal effects.

In particular, the monetary policy of the Swiss national bank was very unusual as the national bank pegged the value of the Swiss franc at the Euro (from September 2011 to January 2015). It is also imaginable that autocorrelation of inflation behaves differently for yearly or bimonthly than for quarterly data.

Using the estimates for π_t from the above regression as expected inflation, it is now possible to compute the values for unexpected inflation (actual inflation minus expected inflation). After the values for expected and unexpected inflation were obtained, the regression as presented in equation E1 was conducted.

$$R_{it} = \alpha_i + \beta_i(E(\pi_t)) + \gamma_i(\pi_t - E(\pi_t)) + \varepsilon_{it} \qquad (E1)$$

This regression leads to the following results on Exhibit 5.

According to the theory of Fisher (1930) presented earlier in this paper, the beta coefficient for expected inflation should be one for all assets. The present results cannot reject this. In addition, the results of previous studies, that Swiss indirect real estate is not a hedge against expected inflation cannot be rejected. However, the sign is always positive, but the standard error of the coefficient is very large, which makes it hard to infer anything from the beta coefficient. We see no significant values as normal levels.

The gamma coefficient for unexpected inflation is always negative (a "reverse" hedge), but only significant at the $p < 0.1$ level for WUPIXF_ret. The hypothesis that Swiss real estate mutual funds are a hedge against unexpected inflation can be rejected. Most likely, Swiss indirect real estate does not provide a hedge against unexpected inflation as suggested by previous studies.

In conclusion, it can be stated that Swiss real estate mutual funds are not a hedge against inflation. It seems also to be very reasonable to state that they do not provide any inflation hedge at all.

Conclusion

Previous research suggested that no inflation hedging ability of indirect real estate exists in Switzerland. This suggestion could not be rejected by the research of the current paper, as all coefficients were not significantly different from zero. The relatively small sample size caused large standard errors of the regression. The current research could reject the hypotheses that Swiss indirect real estate is a complete hedge against total inflation and / or a complete hedge against unexpected inflation. Those results are also in line with the results of previous research conducted for Switzerland.

Several interesting questions in this research field remain still unanswered. Although it is now a widely accepted fact that Swiss real estate does, in contrast to foreign real estate, not provide inflation hedging abilities, nobody has yet been able to establish a theory why this is the case. A possible reason is the rigid tenancy law for private residential purposes in Switzerland, which leads to relatively fixed rents. In our study, we analyzed the hedging ability with quarterly data. We found in the literature some evidence for inflation hedging in the long run, which could be an indication for longer lag structures in the data. And finally, the special situation of Switzerland as a safe haven for investors in turbulent markets has led in the last few years to extremely low interest and inflation rates. And the "search for yield" has boosted the real estate prices in recent years. This could have affected our results.

Endnotes

1. Indirect real estate investments are structured as mutual funds in Switzerland. There's no special legal structure like American REITs.
2. Direct real estate is heterogeneous, indivisible, and illiquid (Garay and Stevenson 2009: 219). Indirect real estate investments are suitable and appropriate for individual investors due to asset diversification, divisibility, liquidity, and professional management of the investment product.
3. An advantage of indirect real estate investments (REITs, mutual funds) is the access to illiquid and indivisible assets for small investors. A disadvantage is the listing on a stock exchange (or an other public market). Real estate prices pick up some systematic risk of that market. It is a less pure play in real estate (Anson, 2009: 69).
4. Therefore, some studies deal with time-lag structures of the return and inflation data.

Variables E1	SWIIT_ret	RUEDIF_ret	WUPIXF_ret
EX_INF	0.617	0.189	1.687
	(2.061)	(2.152)	(2.081)
UNEX_INF	-0.973	-1.136	-1.238*
	(0.716)	(0.747)	(0.695)
Constant	0.0139***	0.0152***	0.0115**
	(0.00465)	(0.00485)	(0.00477)
Observations	81	81	74
JB chi2	0. 3261	0.9916	2.462
JB Prob > chi2	0. 8495	0.6091	0.2919
BP chi2	0.24	0. 31	0.22
BP Prob > chi2	0. 6259	0.5798	0.6389
R-squared	0.024	0.029	0.050

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
JB: Jarque-Bera test for normality (H0: normality). We cannot reject the hypothesis that our returns are normally distributed.
BP: Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (H0: constant variance). We cannot reject the hypothesis that our returns have a constant variance.

Exhibit 5: Regression Results E1
Source: Authors' Calculations

5. There are other methodologies to test the relationship between real estate returns and inflation. (1) Ganesan and Chiang (1998: 56) discuss a simple comparison between these two variables. However, such approaches are generally considered as oversimplified. (2) Furthermore, the model of Fama and Schwert is criticized because it does not reflect possible non-stationarity in the variables (Goetzmann and Valaitis, 2006: 3). Therefore, researcher might reject the tested hypotheses too often. To solve these problems cointegration techniques have been developed. The logic behind these approaches is that even if the real estate returns and inflation rates themselves are non-stationary the linear combination of both might be (Goetzmann and Valaitis, 2006: 3). If this is true the two variables are cointegrated. The regression of those two variables would therefore be meaningful (Ganesan and Chiang, 1998: 63). (3) Wohlwend and Goller (2011) apply a short-term and a long-term sensitivity measurement.

6. In Switzerland, the exchange price is often above the net asset value. A positive agio are common for real estate mutual funds.

7. Examples are: Deutsche Bank Rüd Blass Immobilienfonds Indizes (DBCHREE, DBCHREF); SXI Real Estate Indizes (REAL, REALX, SWIIT, SWIIP, SREAL, SREALX); Wüest & Partner Indizes (WUPIX-A, WUPIX-F).

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