The excess sensitivity of Swiss real estate with respect to mortgage rates: A dynamic discounted cashflow analysis

Presentation Swiss Real Estate Congress, March 23, 2018

Dr. Rudolf Marty, Senior Researcher

Center for Corporate Responsability (CCRS)
and Sustainability at the University of Zuerich

March 2018

Table of Contents

The dynamic discounted cashflow model (DDCF-model)

Theory: Campbell and Shiller's (1988) (CS) log-linear stock return approximation can be applied to the housing market as well:

- Real version, i.e. housing return and rent growth are inflation-adjusted:

$$r_t - p_t = E_t \sum_{j=0}^{\infty} \rho^j [h_{t+1+j} - \Delta r_{t+1+j}] - \frac{c}{1-\rho}$$

where $r_t - p_t$, h_{t+1} [1] , r_{t+1} and p_{t+1} denote log of the rent-price ratio, log real return, log real rent and log real house price, respectively, $\rho = exp(E[\Delta r - h])$ and c is a linearization constant

[1] Note that $h_{t+1} := log(\frac{P_{t+1}+R_{t+1}}{P_t})$.

The dynamic discounted cashflow model (DDCF-model)

Analogy to valuation of stocks: Dynamic dividend growth model

- Dynamic "Gordon" growth model:

$$d_t - p_t = E_t \sum_{j=0}^{\infty} \rho^j [h_{t+1+j} - \Delta d_{t+1+j}] - \frac{c}{1-\rho}$$

where $d_t - p_t$, h_t [2], d_{t+1} and p_{t+1} denote log of the dividend-price ratio, log real return, log real dividend and log real stock price, respectively, $\rho = exp(E[\Delta r - h])$ and c is a linearization constant

BUT: Real estate market not as efficient as stock markets (due to transaction costs, no short sales, etc.)

[2] Note that $h_{t+1} := log(\frac{P_{t+1}+D_{t+1}}{P_t})$.

Statistical model for h_{t+1}, r_{t+1}, $r_{t+1} - p_{t+1}$:VAR(1)-Process

- Housing return process:

$$h_{t+1} = a_h + b_h * (r_t - p_t) + \epsilon_{h,t+1}$$

- Rent growth process:

$$\Delta r_{t+1} = a_r + b_r * (r_t - p_t) + \epsilon_{r,t+1}$$

- Process for log rent-price ratio:

$$r_{t+1} - p_{t+1} = a_{rp} + b_{rp} * (r_t - p_t) + \epsilon_{rp,t+1}$$

- error processes $\epsilon_{h,t+1}$, $\epsilon_{r,t+1}$, $\epsilon_{rp,t+1}$:
  i.i.d. processes (but contemporanously correlated)

Tests of the the real DDCF-model

The DDCF-model's testable implications:

- Real housing return predictability regression:

$$h_{t+j} = a_h + b_{h,j} * (r_t - p_t) + c_{h,j} * i_t + \epsilon_{h,t+j}$$

- Real rent growth predictabiliy regression:

$$\Delta r_{t+j} = a_{rp} + b_{r,j} * (r_t - p_t) + c_{r,j} * i_t + \epsilon_{r,t+j}$$

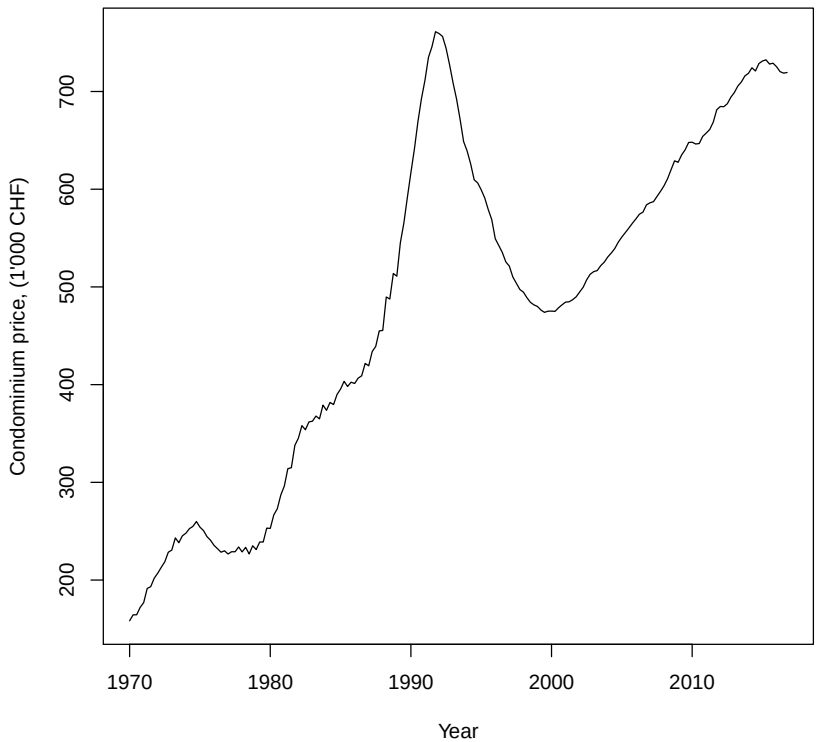
  j: forecast horizon (in quarters);

- Null-hypotheses: $b_{h,j}$: significantly positive, $b_{r,j}$: significantly negative
- Remark: Testing for money illusion, i.e. whether nominal variables impact real ones: $c_{h,j}$ and $c_{r,j}$ are not significantly different from 0

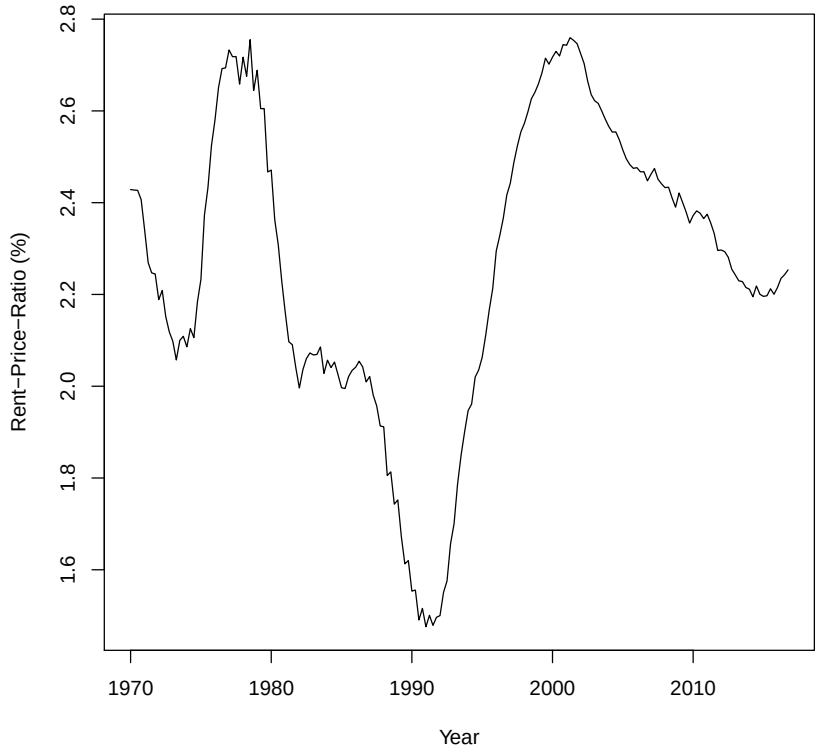
Data I: Data sources and transformations

- Real estate price index (P_t): national quarterly index of condominium offer prices (median of not quality-adjusted single condominium prices with 1 - 5 rooms) ; Source: Wüest Partner, Swiss National Bank (SNB)
- Rent index (R_t): National subindex ("Mietpreisindex') of the consumer price index (CPI); Source: Bundesamt für Statistik (BfS)
- Mortgage rate (i_t): variable mortgage rate; Source: SNB (historical series, 1970M1 - 2008M1), Federal Office of Housing ("Hypothekar-Referenzzinsssatz", since 2008 M2).
- Housing return H_t: $H_t = \frac{P_{t+1}+R_{t+1}}{P_t}$ where R_{t+1} denotes the quarterly rent
- Consumer price index (CPI_{t+1}): National consumer price index; Source: BfS
- Consumer price inflation $\Pi_{t+1} = log(CPI_{t+1}/CPI_t)$

Data II: Housing data

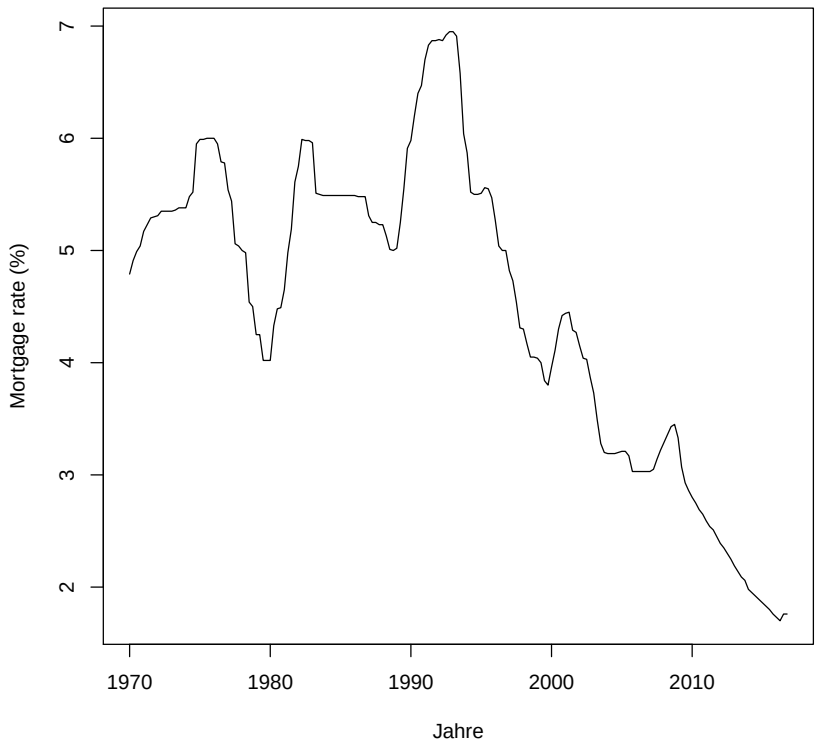


(a) Condominium price

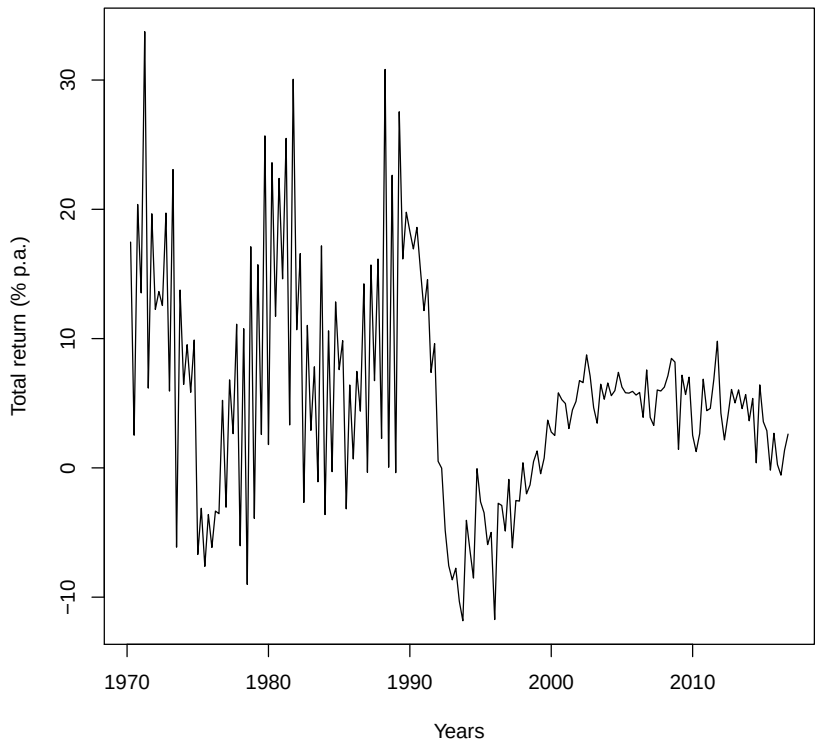


(b) Rent-to-price ratio

Data III: Return data



(c) Mortgage rate



(d) Housing return

Empirical results I: Real housing return predictability

Forecast horizon (qtrs)	Panel A: Real return predictability $h_{t+i} = a_{h,i} + b_{h,i}(r_t - p_t) + c_{r,i} i_t + \epsilon_{h,t+i}$							
	$\hat{b}_h$	$\hat{t}_{b,NW}$	P-v.	$\hat{c}_h$	$\hat{t}_{c,NW}$	P-v.	R^2	NOB
i=1	-6.35	-0.87	0.40	**-1.53**	-1.80	0.03	0.05	184
i=2	-5.45	-0.69	0.49	**-1.54**	-2.14	0.03	0.09	183
i=4	-2.81	-0.35	0.73	**-1.55**	-2.21	0.03	0.12	181
i=8	1.49	0.20	0.84	**-1.55**	-2.42	0.02	0.17	177
i=16	7.85	1.54	0.12	**-1.15**	-2.36	0.02	0.30	169
i=32	**9.34**	16.78	0.00	**-0.54**	-5.86	0.00	0.92	153

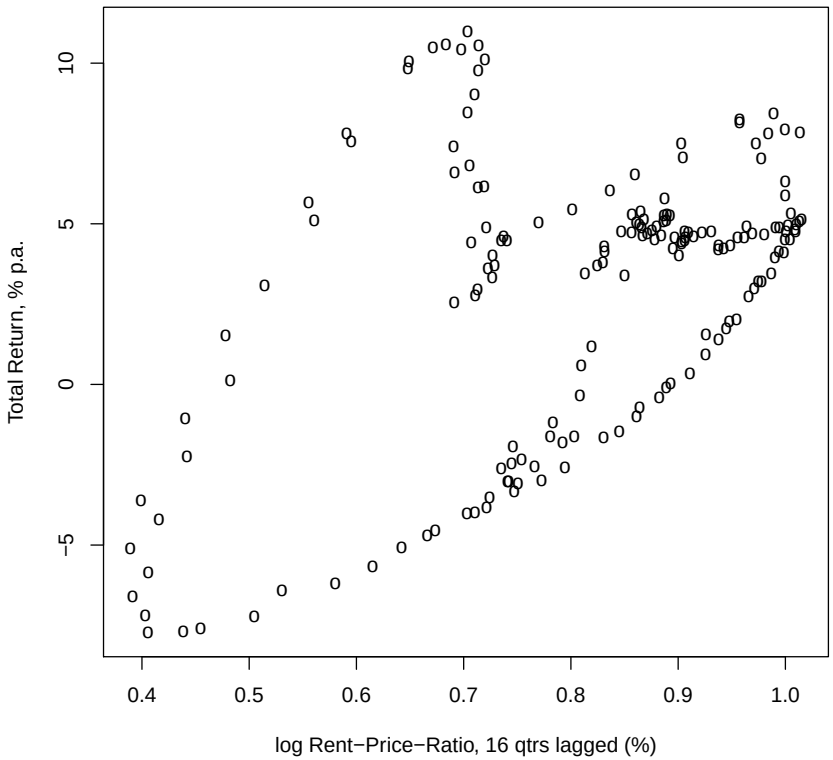
Notes: Source: Wüest Partner, SNB, BfS ; $\hat{t}_{c,NW}$: Newey-West t-statistic; P-v.: probability value

Empirical results I: Real rent growth predictability

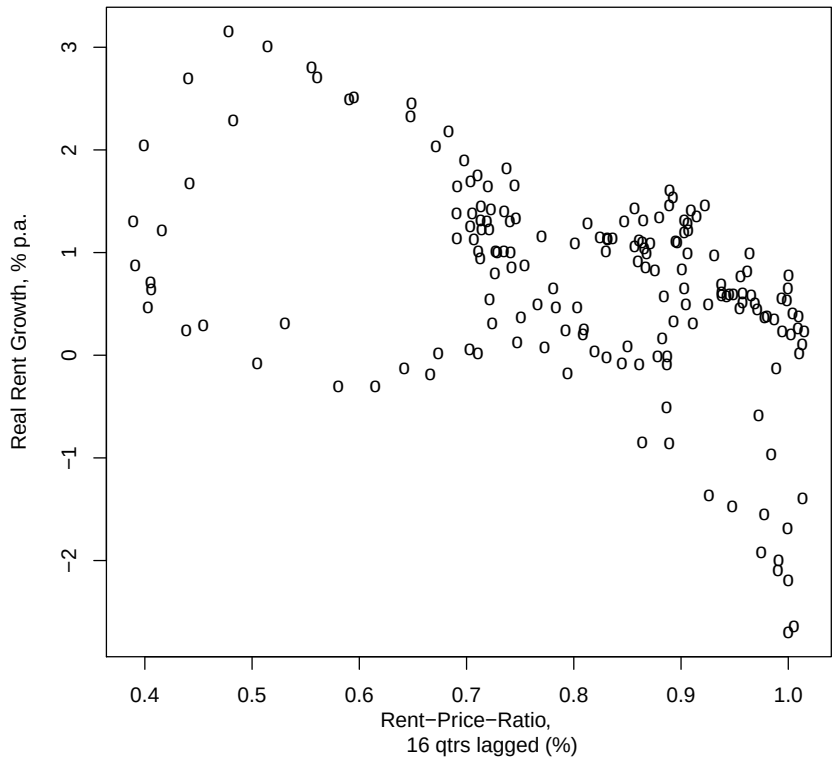
Forecast horizon (qtrs)	Panel B: real rent growth predictability $r_{t+i} = a_{h,i} + b_{h,i}(r_t - p_t) + c_{r,i} i_t + \epsilon_{r,t+i}$							
	$\hat{b}_h$	$\hat{t}_{b,NW}$	P-v.	$\hat{c}_h$	$\hat{t}_{c,NW}$	P-v.	R^2	NOB
i=1	**-5.28**	-3.29	0.00	-0.14	-0.95	0.35	0.02	184
i=2	-1.56	-1.25	0.21	**-0.50**	-3.60	0.00	0.08	183
i=4	**-5.79**	-3.95	0.00	**-0.26**	-1.83	0.07	0.18	181
i=8	**-6.53**	-4.84	0.00	**-0.48**	-3.62	0.00	0.34	177
i=16	**-6.05**	-4.65	0.00	**-0.66**	-4.17	0.00	0.60	169
i=32	**-3.16**	-5.68	0.00	**-0.54**	-5.68	0.00	0.32	153

Notes: Source: Wüest Partner, SNB, BfS; $\hat{t}_{c,NW}$: Newey-West t-statistic; P-v.: probability value

Empirical results I: Lagged r_t/p_t as a forecasting tool



(e) $r - p_t$ forecasts h_{t+16}



(f) $r - p_t$ forecasts r_{t+16}

Conclusions I

The main findings of the DDCF model's empirical tests are:

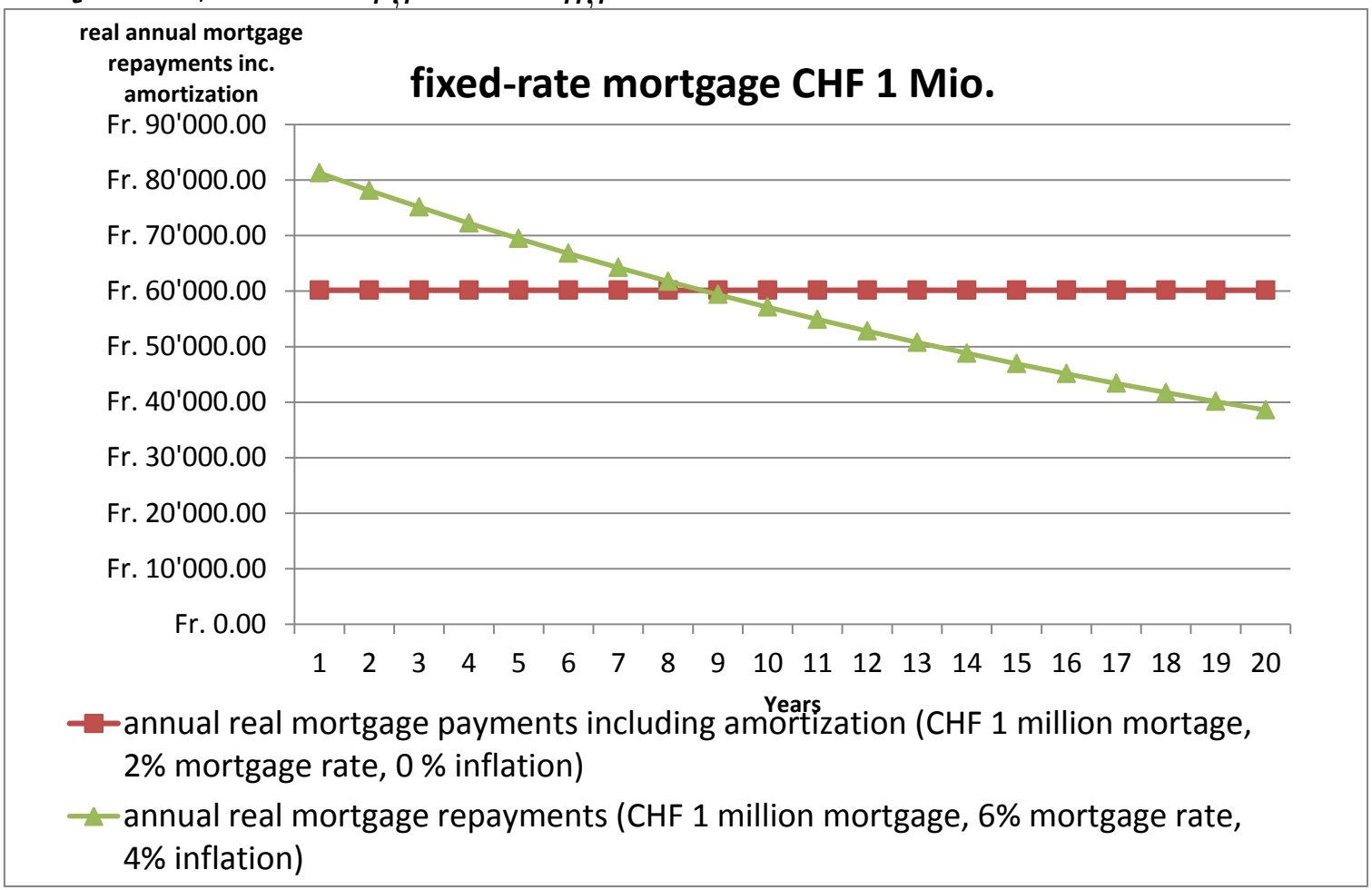
- By and large, CS's DDCF-model seems to fit the Swiss real estate market's time-series data well.
- $log(R_t/P_t)$ positively predicts the real estate market's medium- to long-term return (which is in line with DDCF-model).
- $log(R_t/P_t)$ negatively predicts the short- to medium-term rent growth (which is in line with DDCF-model).
- **HOWEVER: There is a significant (negative) impact of the mortgage rate on real return and real rent growth (hard to explain, needs to be investigated further).**

Money illusion vs. market frictions in the real estate market

- Money illusion in real estate market:
  Inflation Π_t is useful in predicting future real housing returns and future real rents
- Market frictions in real estate market:
  - "Tilt" effect of inflation
  - "lock-in" effects of very low nominal mortgage rate
- How to discriminate between money illusion and market frictions:
  - Inflation-augmented real DDCF-model:
    $h_{t+j} = a_h + b_{h,j} * (r_t - p_t) + c_{h,j} * i_t + d_{\Pi,j} * \Pi_t + \epsilon_{h,t+j}$
  - Prediction of market frictions: $c_{h,j} \neq 0$
  - Prediction of money illusion: $d_{\Pi,j} \neq 0$

Reasons for mortgage rate effect: Tilt effect of inflation

- If $\Pi_t = 0$, then $c_{r,i}$ and $c_{h,i}$ should b zero as well:



Inflation-augmented real DDCF-model: Empirical results II

Panel A: inflation-augmented real return predictability model

$$h_{t+i} = a_{h,i} + b_{h,i}(r_t - p_t) + c_{h,i} i_t + d_{\Pi,i} * \Pi_t + \epsilon_{h,t+i}$$

i (qtrs)	i=1	i=2	i=4	i=8	i=16	i=32
$\hat{b}_h$	-5.47	-4.46	-2.29	1.57	7.60	**9.21**
$\hat{t}_{b,NW}$	-0.77	-1.44	-0.20	0.20	1.41	15.08
P-value	0.44	0.15	0.84	0.84	0.16	0.00
$\hat{c}_h$	**-2.10**	**-2.02**	**-1.89**	**-1.67**	**-1.10**	**-0.52**
$\hat{t}_{c,NW}$	-3.0	-5.44	-2.21	-2.58	-1.93	-5.62
P-value	0.00	0.00	0.01	0.02	0.05	0.00
$\hat{d}_\Pi$	**0.58**	**0.50**	0.33	0.12	-0.07	-0.03
$\hat{t}_{\Pi,NW}$	2.26	3.92	1.24	0.47	-0.37	-1.04
P-value	0.00	0.00	0.22	0.64	0.71	0.30
R^2	0.10	0.16	0.15	0.18	0.30	0.92

Inflation-augmented real DDCF-model: Empirical results II

Panel B: inflation-augmented real rent predictability model

$$r_{t+i} = a_{r,i} + b_{r,i}(r_t - p_t) + c_{r,i} i_t + c_{\Pi,r} * \Pi_t + \epsilon_{r,t+i}$$

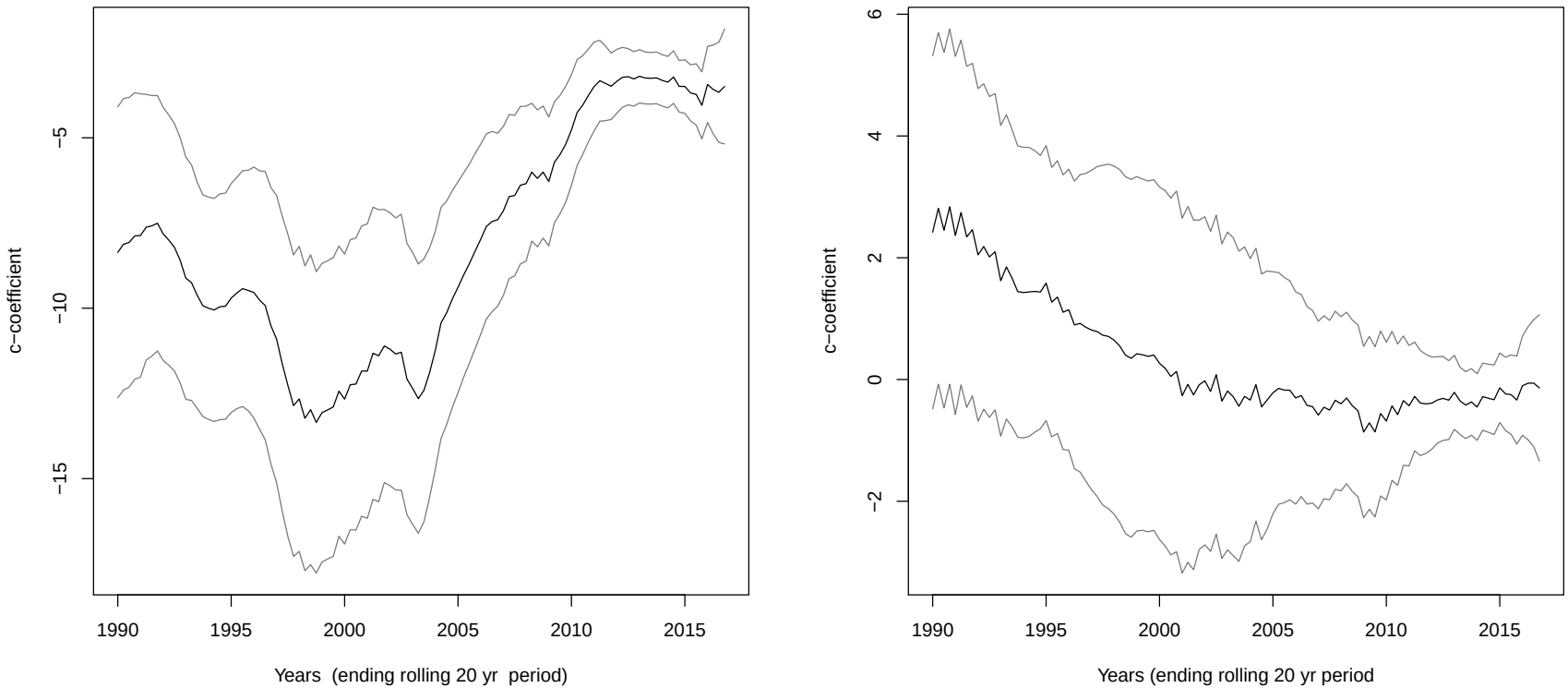
i (qtrs)	i=1	i=2	i=4	i=8	i=16	i=32
$\hat{b}_r$	**-5.42**	-1.71	**-5.66**	**-6.40**	**5.94**	3.28
$\hat{t}_{b,NW}$	-1.44	-1.44	-4.10	-4.45	-4.59	-5.36
P-value	0.15	0.15	0.00	0.00	0.00	0.00
$\hat{c}_r$	-0.23	**-0.43**	**-0.34**	**-0.55**	**-0.70**	**-0.52**
$\hat{t}_{c,NW}$	-3.33	-5.44	-2.61	-4.19	-4.35	-5.61
P-value	0.00	0.00	0.01	0.00	0.00	0.00
$\hat{d}_\Pi$	0.07	-0.08	0.08	**0.08**	**0.04**	-0.03
$\hat{t}_{\Pi,NW}$	0.64	-1.45	1.20	1.67	2.08	-1.04
P-value	0.52	0.14	0.23	0.09	0.04	1.04
R^2	0.03	0.09	0.20	0.38	062	0.35

Conclusions II: Money illusion vs. market frictions

- Empirical findings:
  - (Negative) mortgage impact on real house price apprecation and real rent growth is far more important than inflation effect.
  - (Positive) inflation effect ("real estate as an inflation hedge") only partially offsets negative mortgage effect on real house price appreciation and real rent growth.
- Conclusions: Why do nominal mortgage rates have such a (long-lasting) impact on real house prices and real rents:
  - "Tilt effect" of inflation on real mortgage repayment profile: very relevant
  - "Lock-in" effect of mortgage rates (possibly also relevant, but not yet investigated)

Reasons for mortgage rate effect: Tilt effect of inflation

Figure: i_t coefficients, rolling 20-year samples 90Q4-16Q4



(a) $c_{h,1}$ and 95 Percent confidence bound (b) $c_{r,1}$ and 95 Percent confidence bound

How relevant is houshold debt: international evidence

(c) Switzerland has largest private debt to GDP ratio (source: FT)

Summary and additional information

- Summary:
  - The dynamic discounted cashflow model applied to the Swiss housing market yields encouraging results
  - The nominal mortgage rates' impact on the Swiss housing market seems to be due mainly to market frictions
- Additional information:
  - **www.ccrs.uzh.ch**
  - **sites.google.com/view/marty-research**
  - **rudolf.marty2@ccrs.uzh.ch**
- THANK YOU FOR YOUR ATTENTION!