

# Inflation Illusion and Institutional Ownership in REITs

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# Objectives - Are Institutions Inflation-Illusioned?

- explores rational portfolio tilting implications of the Modigliani-Cohn (1979) inflation illusion hypothesis within the US public REITs market.
  - **Modigliani-Cohn Hypothesis:** a behavioral explanation of the empirical failure of the Fisher effect – because stocks are claims on real assets, nominal stock returns ought to co-vary positively with actual inflation.
- use Tobit estimation to determine whether institutional ownership in REITs stocks vary with level of expected and unexpected inflation.
  - Institutional investors = marginal investors of US public REITs market.
  - Institutions tend to have more informational resources  $\Rightarrow$  more rational

# Background

Studies that look at the asset-pricing implications of the Modigliani-Cohn's hypothesis

- Stock market (for example, Ritter and Warr (2002), Campbell and Vuolteenaho (2004)).
- U.S. residential market (Brunnermeier and Julliard (2008), Piazzesi and Schenider (2008)).
- U.S. public REIT market (Hardin III, et al. (2010), Hong and Lee (2011))

Evidence of inflation-induced mispricing is evaluated only at the conditional mean of the price distribution. This does not indicate nor imply that all investors within the market are inflation-illusioned.

- Rational investors could still bet against inflation-induced mispricing which might not be fully eliminated if such mispricing is slow-correcting (Shleifer and Vishny (1997)).

# Rationale

The question of whether rational investors (institutions) suffer from inflation illusion or carry out trades that bet against mispricing can be answered by directly looking at

- Institutional ownership of good and bad hedges
- How the ownership patterns vary with the level of expected and unexpected inflation

Inflation Illusion Hypothesis:

- Bad hedges are undervalued (overvalued) when inflation is high (low);
  - ⇒ Rational investor will tilt his portfolio toward bad hedges when inflation is high
  - ⇒ Rational investor will tilt away from bad hedges when inflation is low

# Rationale

Under the null hypothesis:

- if all investors (institutional or otherwise) are rational, institutions will tilt toward good hedges when expected inflation is high.
- if all investors are illusioned, institutions will tilt toward good hedges and away from bad hedges when expected inflation is high - thus driving a wedge between the prices of good and bad hedges.

# Empirical Strategy

**Main test:** examine the time variation of institutional ownership in good and bad hedges, and the relation of this time variation to expected and unexpected inflation.

- 1 Identify REIT stocks' effectiveness as a hedge against expected and unexpected inflation;
- 2 Rank REIT stocks into bad-good-hedges quintile groups;
- 3 Using Institutional ownership as a dependent variable, run tobit regressions for each quintile group;
- 4 Right-hand side variables include liquidity and prudent considerations, momentum, expected and unexpected inflation rates;

## Determining good and bad hedges

Each REIT stock's inflation-hedging ability is estimated following Fama and Schwert (1977):

$$\tilde{R}_{i,t} = \alpha_i^I + \beta_{i,t}^I EI_t + \gamma_{i,t}^I UEI_t + \tilde{\eta}_{i,t} \quad (1)$$

where

- $\tilde{R}_{i,t}$  is the nominal return on REIT  $i$  in month  $t$ ,
- $EI_t$  is the expected inflation rate (use return on t-bill which matures at end of  $t$ )
- **inflation-beta:**  $\hat{\beta}_{i,t}^I = 1$  indicates that asset is a perfect hedge against expected inflation rate
- **inflation-gamma:**  $\hat{\gamma}_{i,t}^I = 1$  indicates that the asset is a perfect hedge against unexpected inflation.
- $UEI_t = I_t - EI_t$ , difference between actual inflation rate and expected inflation rate.

# Estimating $\beta_{i,t}^I$ and $\gamma_{i,t}^I$

- **Data: spans from 1990:1 through 2009:9**
  - Monthly REIT stock returns,  $R_{i,t}$ , are obtained from CRSP;
  - Monthly inflation rates,  $I_t$ , are obtained from CPI series via U.S. Bureau of Labor Statistics
  - Monthly t-bill rates,  $EL_t$ , are obtained from Ibbotson and Associates, Inc.
- Estimation of monthly  $\beta_{i,t}^I$  and  $\gamma_{i,t}^I$  for individual REIT stock are made using trailing 6 to up to 36 monthly returns in OLS regression following (1).
- Monthly REIT-level estimates are then averaged over calendar quarters, resulting in 67 quarterly cross-sectional observations. The averaged  $\hat{\beta}_{i,t}^I$  and  $\hat{\gamma}_{i,t}^I$  are used to form inflation-beta and inflation-gamma-sorted quintile groups.
- Quintile groups are re-formed each quarter using most recent estimates of inflation-beta or inflation-gamma.



# Percentile cut-off values for $\hat{\beta}_{i,t}^I$ and $\hat{\gamma}_{i,t}^I$

## Percentile Cut-offs

	20	40	60	80
Average $\beta^I$	-13.00	-1.20	6.69	18.06
S.D.	12.21	10.25	11.00	14.21
Average $\gamma^I$	-5.1	-1.52	1.42	4.98
S.D.	2.52	1.79	2.23	3.73

# Institutional Ownership

$$PCTIO = \alpha + \rho Z + \delta Y + u \quad (2)$$

where  $Z$  is a vector of the REIT characteristics that affects institutional ownership:

- 1 Dividend yield.
- 2 Volatility
- 3 Price, per share.
- 4 Size, which is last quarter price per share times number of shares outstanding.
- 5 Turnover: volume divided by shares outstanding measured for the month prior to the beginning of the quarter
- 6 Momentum: return for the month prior to the beginning of the current quarter .

## Institutional Ownership - cont'd

and  $Y$  is a vector of inflation variables, and includes the following:

- 1  $EI$ : inflation rate, in percentage, of the month prior to beginning of current quarter.
- 2  $UEI$  : unexpected inflation rate, in percentage, of the month prior to beginning of current quarter.

$PCTIO$  is expressed as a percentage. Institutional holdings of REIT stocks is summed up in each quarter and is expressed as a percentage of the number of shares outstanding (obtained from CRSP/Zirman).

# Tobit estimation

$$PCTIO = \alpha + \rho Z + \delta Y + u$$

is estimated using a Tobit estimation due to the following reasons:

- 13F only applies to institutions with greater than USD100 million of securities under discretionary management; and requires a threshold reporting level of \$200,000 or 10,000 shares. If a REIT is not held by any institutions, *PCTIO* is set to 0. This will impart a downward bias.
- Because *PCTIO* is in percentage, the data has a pileup at 0 and 100. The pile-up at 0 is from data-censoring but the pile-up at 100 is a “corner-solution” outcome.

⇒ Tobit estimates are obtained by specifying 0 and 100 as the lower and upper bounds. Interpretation is based on a Type 1 Tobit Model – *PCTIO* is a nonlinear function of *Z* and *Y*.

# Results by Inflation-beta Quintile Group.

Dependent variable is *PCTIO*.

	<u>Quintile 1</u>	<u>Quintile 2</u>	<u>Quintile 3</u>	<u>Quintile 4</u>	<u>Quintile 5</u>
Intercept	-11.064 *** (3.791)	-40.303 *** (4.331)	-44.945 *** (4.117)	-43.133 *** (4.050)	-10.444 *** (3.006)
Dividend Yield	0.011 (0.011)	-0.025 (0.030)	0.051 ** (0.023)	-0.050 * (0.021)	-0.021 (0.022)
Volatility	-0.468 (0.126)	0.413 ** (0.185)	0.498 *** (0.194)	-0.105 (0.184)	-0.072 (0.064)
Log(Size)	6.843 *** (0.947)	11.703 *** (1.244)	11.395 *** (1.257)	9.355 *** (1.071)	7.838 *** (0.902)
Log(Size) <sup>2</sup>	0.783 *** (0.190)	-0.167 (0.162)	-0.357 ** (0.167)	0.015 (0.146)	0.610 *** (0.181)
Log(Price)	-1.369 (0.997)	4.071 *** (1.221)	5.689 *** (1.174)	2.852 ** (1.168)	-1.672 * (0.955)
Log(Turnover)	6.507 *** (0.588)	7.612 *** (0.680)	8.803 *** (0.710)	10.294 *** (0.685)	4.163 *** (0.553)
Momentum	0.156 * (0.087)	0.041 (0.110)	0.008 (0.096)	0.176 ** (0.086)	0.038 (0.063)
Expected Inflation	-4.721 (4.922)	-5.672 (4.229)	-11.962 *** (4.022)	-1.618 (4.157)	-0.770 (4.510)
Unexpected Inflation	2.351 (1.980)	-2.568 * (1.533)	0.068 (1.401)	0.153 (1.433)	0.778 (1.752)
$\sigma$	11.809 *** (0.734)	25.114 *** (0.481)	23.255 *** (0.529)	24.518 *** (0.441)	11.212 *** (0.683)
Loglikelihood	-7313	-9917	-10134	-9356	-7345
No. of observations	1833	2411	2488	2336	1842
R <sup>2</sup>	0.07	0.07	0.07	0.10	0.06

# Results by Inflation-gamma Quintile Group.

	<u>Quintile 1</u>	<u>Quintile 2</u>	<u>Quintile 3</u>	<u>Quintile 4</u>	<u>Quintile 5</u>
Intercept	-46.379 *** (4.309)	-46.974 *** (4.660)	-25.279 *** (4.151)	-29.744 *** (4.005)	-17.377 *** (3.776)
Dividend Yield	-0.009 (0.015)	-0.029 (0.030)	0.003 (0.015)	-0.067 *** (0.021)	0.007 (0.024)
Volatility	-0.057 (0.115)	-0.306 * (0.188)	-0.057 (0.162)	0.473 *** (0.182)	-0.200 (0.130)
Log(Size)	11.673 *** (1.482)	12.682 *** (1.551)	12.731 *** (1.202)	4.530 *** (1.015)	7.537 *** (0.929)
Log(Size) <sup>2</sup>	-0.659 *** (0.209)	-0.869 *** (0.189)	-0.143 (0.170)	1.025 *** (0.148)	0.787 *** (0.148)
Log(Price)	3.810 *** (1.167)	4.060 *** (1.287)	1.798 (1.198)	2.561 ** (1.150)	-0.305 (1.160)
Log(Turnover)	10.602 *** (0.709)	11.906 *** (0.733)	5.795 *** (0.632)	7.617 *** (0.677)	6.142 *** (0.631)
Momentum	0.342 *** (0.095)	0.085 (0.107)	0.254 *** (0.089)	0.207 ** (0.092)	-0.077 (0.080)
Expected Inflation	8.797 * (5.128)	-2.773 (4.566)	-14.569 *** (4.136)	-10.522 *** (3.922)	-18.250 *** (4.433)
Unexpected Inflation	-1.900 (1.967)	1.134 (1.650)	-0.112 (1.471)	0.572 (1.377)	-0.597 (1.606)
$\sigma$	26.334 *** (0.926)	27.289 *** (0.551)	24.235 *** (0.482)	23.241 *** (0.464)	23.308 *** (0.537)
Loglikelihood	-8182	-10152	-9952	-9356	-6736
No. of observations	1968	2414	2422	2336	1838
R <sup>2</sup>	0.05	0.05	0.07	0.07	0.08

# Marginal Effects

	<u>Quintile 1</u>	<u>Quintile 2</u>	<u>Quintile 3</u>	<u>Quintile 4</u>	<u>Quintile 5</u>
Dividend Yield	0.24	0.07	0.00	-0.06	0.00
Volatility	-0.04	-0.24	-0.05	0.40	-0.15
Size	0.13	0.10	0.21	0.22	0.24
Price	0.07	0.07	0.03	0.05	-0.01
Turnover	0.19	0.20	0.10	0.15	0.13
Momentum	0.24	0.07	0.22	0.17	-0.06
Expected Inflation	6.19 0.15 <sup>§</sup>	-2.20 -0.05 <sup>§</sup>	-12.84 -0.32 <sup>§</sup>	-8.80 -0.22 <sup>§</sup>	-13.59 -0.34 <sup>§</sup>
Unexpected Inflation	-1.34 -0.03 <sup>§</sup>	0.90 0.02 <sup>§</sup>	-0.10 0.00 <sup>§</sup>	0.48 0.01 <sup>§</sup>	-0.44 -0.01 <sup>§</sup>
No. of observations	1968	2414	2422	2336	1838

# Tobit estimation controlling for mispricing

To mitigate the possibility that the effect on expected inflation is due to unobserved risk preferences that are correlated with expected inflation, the Tobit regressions are run again to controlling for mispricing (Brennan and Wang [2010]).



# Tobit estimation controlling for mispricing

	<u>Quintile 1</u>	<u>Quintile 2</u>	<u>Quintile 3</u>	<u>Quintile 4</u>	<u>Quintile 5</u>
Intercept	-46.860 *** (4.346)	-48.025 *** (4.700)	-25.804 *** (4.154)	-29.907 *** (4.003)	-17.602 *** (3.782)
Dividend Yield	-0.009 (0.015)	-0.031 (0.030)	0.002 (0.015)	-0.070 *** (0.021)	0.006 (0.024)
Volatility	-0.052 (0.116)	-0.268 (0.189)	-0.058 (0.163)	0.478 *** (0.182)	-0.200 (0.130)
Log(Size)	11.740 *** (1.484)	12.823 *** (1.551)	12.867 *** (1.203)	4.535 *** (1.014)	7.574 *** (0.930)
Log(Size) <sup>2</sup>	-0.671 *** (0.210)	-0.888 *** (0.189)	-0.158 (0.170)	1.022 *** (0.148)	0.780 *** (0.148)
Log(Price)	3.920 *** (1.174)	4.229 *** (1.289)	1.904 (1.198)	2.620 ** (1.150)	-0.239 (1.161)
Log(Turnover)	10.611 *** (0.709)	11.900 *** (0.732)	5.773 *** (0.632)	7.617 *** (0.677)	6.138 *** (0.631)
Momentum	0.350 *** (0.096)	0.100 *** (0.107)	0.262 *** (0.089)	0.217 *** (0.092)	-0.069 (0.080)
Expected Inflation	9.009 * (5.135)	-1.899 (4.588)	-14.331 *** (4.133)	-10.409 *** (3.920)	-18.105 *** (4.434)
Unexpected Inflation	-1.676 (1.986)	1.622 (1.670)	0.010 (1.471)	0.665 (1.377)	-0.571 (1.597)
Mispricing	0.164 (0.192)	0.468 * (0.254)	0.433 ** (0.216)	0.274 (0.191)	0.162 (0.171)
$\sigma$	26.343 *** (0.923)	27.266 *** (0.553)	24.231 *** (0.478)	23.232 *** (0.462)	23.303 *** (0.537)
Loglikelihood	-8182	-10150	-9950	-9355	-6736
No. of observations	1968	2414	2422	2336	1838
R <sup>2</sup>	0.05	0.05	0.07	0.07	0.08

# Conclusion

- Examines whether institutional investors suffer from inflation illusion in U.S. public REITs market.
- Explores the portfolio implications of the Modigliani-Cohn (1979) hypothesis.
- Institutions tilt away from good hedges and toward bad hedges in periods of high inflation, holding constant other reasons that may influence institutional ownership.
  - when inflation-gamma is used to rank how effective an inflation-hedge a REIT stock is;
  - tilting effect remains robust after controlling for risk-adjusted mispricing that could be correlated with inflation.