Money Illusion and Housing Frenzies

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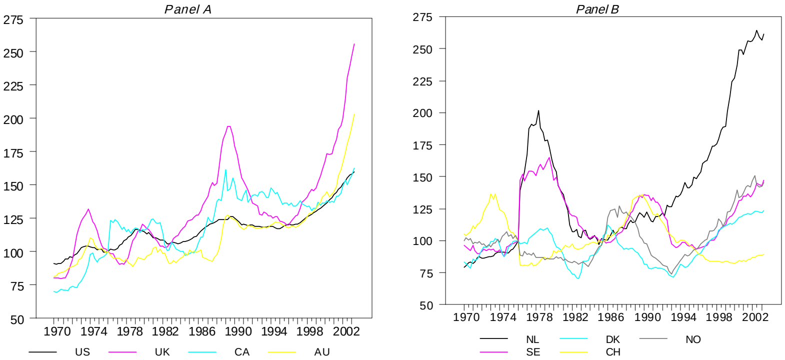
House prices in different countries



- What explains these sharp movements?
- Focus: Role of inflation

Mortgages, money illusion and house prices

Decision: Monthly **rent** *versus* monthly **mortgage payments**

⇒ *Example* of money/inflation illusion

decline in inflation ⇒ decline in nominal interest rate i

⇒ monthly payments decline

⇒ larger mortgage ⇒ higher house prices

BUT

⇒ future mortgage payments are larger in real terms (mortgage is not inflated away.)

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Decomposing price movements

Stage 1: Focus on price-rent ratio (P_t/L_t)

- abstracts from movements of fundamentals that affect prices and rents symmetrically (demographics, land cost etc.)
- not perfect substitutes: pride of ownership, ...

Stage 2: Decompose price-rent ratio in

- expected return (incl. risk premium)
- expected rent growth rate
- "mispricing"

Inflation effect on each part

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Outline

1. Money illusion - Related literature
2. U.K. evidence
   - Real versus nominal - A first-cut
   - Decomposing inflation effects
   - Financial frictions
3. Cross-country evidence
   - U.S. evidence
4. Conclusion

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"An economic theorist can, of course, commit no greater crime than to assume money illusion." Tobin (1972)

- **Money Illusion:**
  Patinkin (1965), Leontief (1936), Fisher (1928)

  > *"That shirt I sold you will cost me just as much to replace as I am charging you [...] But I have made a profit on that shirt because I bought it for less."*

- **Recent survey evidence:**
  Shiller (1997a), (1997b)
- **Related Psychological Biases:**
  Shafir, Diamond, Tversky (1997), ...
- **Stock market:**
  Modigliani-Cohn (1979), Asness (2000, 2003), Ritter-Warr (2002), Campbell-Vuolteenaho (2004), Cohen et al. (2005)

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A first cut

$$\text{PV of permanent service flow} \quad = \quad L + \frac{L}{1+r} + \frac{L}{(1+r)^2} + \ldots$$

$$\frac{P_t}{L_t} = E_t\left[\sum_{\tau=t+1}^{\infty} \frac{1}{(1+r_\tau)^{\tau-t-1}}\right] \simeq \frac{1}{r}$$

with money illusion

$$\frac{P_t}{L_t} = \tilde{E}_t\left[\sum_{\tau=t+1}^{\infty} \frac{1}{(1+r_\tau)^{\tau-t-1}}\right] \simeq E_t\left[\sum_{\tau=t+1}^{\infty} \frac{1}{(1+i_\tau)^{\tau-t-1}}\right] \simeq \frac{1}{i}$$

- Regress P_t/L_t separately on $1/r_t$, $1/i_t$, and π_t.

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Forecasting regressions

- Regress P_t/L_t separately on $1/r_t$, $1/i_t$, and π_t.
- Persistence of P_t/L_t and regressors might lead to spurious results.
- Regress forecasts error on $1/r$, $1/i$, and π.

$$\hat{\delta}_{t+1,t+1-s} = \begin{cases} P_{t+1}/L_{t+1} & \text{for } s = 0 \\ P_{t+1}/L_{t+1} - \hat{E}_{t-s}\left[P_{t+1}/L_{t+1}\right] & \text{for } s > 0 \end{cases}$$

where $\hat{E}_{t-s}[P_t/L_t]$ reduced form VAR for P_t/L_t, log gross return, $r_{h,t}$, the rent growth rate Δl_t and the log real interest rate, r_t.

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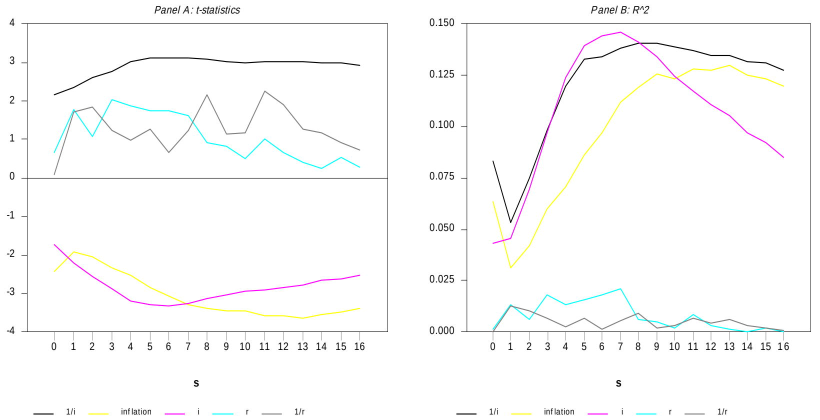
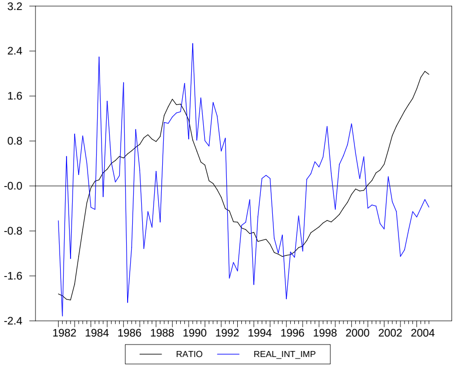


Figure 3: t-statistics and R^2 of univariate regressions of the forecast error $\hat{\delta}_{t+1,t+1-\tau}$ on interest rates and interest rate reciprocals (both nominal and real) as well as inflation.

Price-rent ratio and TIPS implied real interest rates



(standardized series)

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Decomposing inflation effects

$$R_{h,t+1} = \frac{P_{t+1} + L_{t+1}}{P_t}$$

- Log-linearize around steady state and iterate

$$p_t - l_t = \lim_{T\to\infty} \left[\sum_{\tau=1}^{T-1} \rho^{\tau-1} \left(\Delta l_{t+\tau} - r_{h,t+\tau} \right) + \rho^{T} \left(p_{t+T} - l_{t+T} \right) \right].$$

- Note if p_t is distorted, then so are all realized $r_{h,t+\tau}$
- Subtract r^f to obtain excess Δl^e and excess returns r^e
- Take expectations: E (objective), $\tilde{E}$ (subjective)

Construction of ψ-Mispricing

- Taking expectations and assuming that TVCs hold

$$p_t - l_t = \sum_{\tau=1}^{\infty} \rho^{\tau-1} E_t \left[\Delta l^e_{t+\tau}\right] - \sum_{\tau=1}^{\infty} \rho^{\tau-1} E_t \left[r^e_{h,t+\tau}\right] \quad \text{rational traders}$$

$$= \sum_{\tau=1}^{\infty} \rho^{\tau-1} \tilde{E}_t \left[\Delta l^e_{t+\tau}\right] - \sum_{\tau=1}^{\infty} \rho^{\tau-1} \tilde{E}_t \left[r^e_{h,t+\tau}\right] \quad \text{irrational traders}$$

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ψ_t-Mispricing measure

$$\psi_t := \sum_{\tau=1}^{\infty} \rho^{\tau-1} \left(\tilde{E}_t - E_t\right) \left[\Delta l^e_{t+\tau}\right]$$

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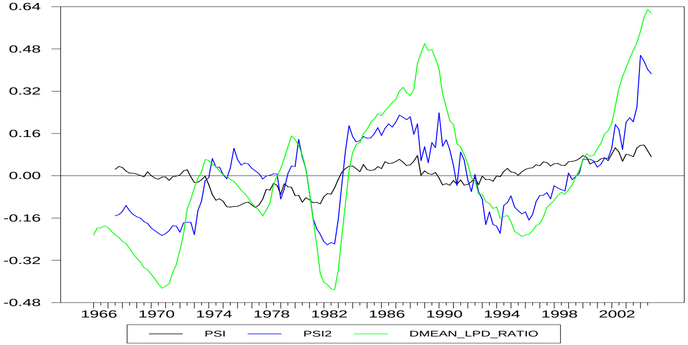
The different measures of mispricing

- ψ-mispricing measure depends on added controls for ξ.
  1. ψ with controls (quarterly dummies, VAR(1)-forecast)
  2. ψ' without controls



ε-Mispricing

ε_t-Mispricing measure (very conservative)

$$\varepsilon_t := \sum_{\tau=1}^{\infty} \rho^{\tau-1} \left(\tilde{E}_t - E_t\right) \left[\Delta l^e_{t+\tau} - r^e_{h,t+\tau}\right] + \tilde{E}_t \left[\lim_{T\to\infty} \rho^T \left(p_{t+T} - l_{t+T}\right)\right]$$

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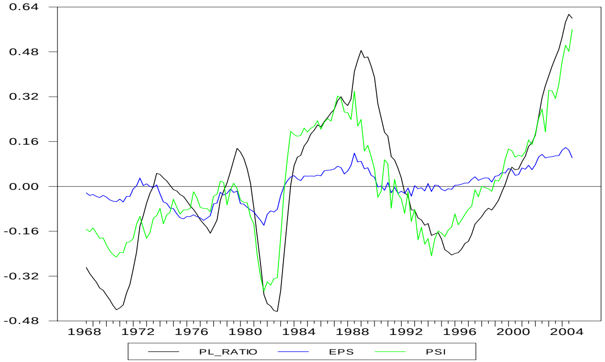
- violation of the TVC under the objective measure

ε-Mispricing

- ε-Mispricing measure
  - non-neglectable
  - martingale property cannot be rejected
  - analysis holds in first differences



Empirical evidence

Dependent Variables:	Regressors:					
	π_t		i_t		$\log(1/i_t)$	
	coeff.	R^2	coeff.	R^2	coeff.	R^2
Panel A						
$\hat{\psi}_t$	-4.09 (13.479)	.83	-6.80 (11.765)	.74	.136 (8.020)	.69
$\sum_{\tau=1}^{\infty} \rho^{\tau-1} \hat{E}_t \Delta l^e_{t+\tau}$	-2.58 (2.390)	.12	-3.96 (1.938)	.09	.093 (2.083)	.12
$-\sum_{\tau=1}^{\infty} \rho^{\tau-1} \tilde{E}_t r^e_{h,t+\tau}$	1.92 (1.066)	.03	3.581 (1.050)	.03	$-.050$ (.595)	.02
Panel B						
$\hat{\psi}'_t$	-6.15 (2.48)	.17	-10.85 (2.66)	.17	.241 (2.82)	.19
$\hat{\varepsilon}_t$	-3.90 (7.946)	.65	-6.3 (6.927)	.55	.129 (5.991)	.52

Table 1: Univariate Regressions, Newey-West (1987) corrected t-statistics in brackets.

Empirical evidence

Dependent Variables:	Regressors:					
	π_t		i_t		$\log(1/i_t)$	
	coeff.	R^2	coeff.	R^2	coeff.	R^2
Panel A						
$\hat{\psi}_t$	-4.09 (13.479)	.83	-6.80 (11.765)	.74	.136 (8.020)	.69
$\sum_{\tau=1}^{\infty} \rho^{\tau-1} \hat{E}_t \Delta l^e_{t+\tau}$	-2.58 (2.390)	.12	-3.96 (1.938)	.09	.093 (2.083)	.12
$-\sum_{\tau=1}^{\infty} \rho^{\tau-1} \tilde{E}_t r^e_{h,t+\tau}$	1.92 (1.066)	.03	3.581 (1.050)	.03	$-.050$ (.595)	.02
Panel B						
$\hat{\psi}'_t$	-6.15 (2.48)	.17	-10.85 (2.66)	.17	.241 (2.82)	.19
$\hat{\varepsilon}_t$	-3.90 (7.946)	.65	-6.3 (6.927)	.55	.129 (5.991)	.52

Table 1: Univariate Regressions, Newey-West (1987) corrected t-statistics in brackets.

Empirical evidence

Dependent Variables:	Regressors:					
	π_t coeff.	R^2	i_t coeff.	R^2	$\log(1/i_t)$ coeff.	R^2
Panel A						
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Table 1: Univariate Regressions, Newey-West (1987) corrected t-statistics in brackets.

Robustness analysis - Methodology

Posterior of estimated VAR (under diffuse prior, sample size n and m parameters)

$$\beta|_{\Sigma} \sim N\left(\hat{\beta}, \Sigma \otimes (X'X)^{-1}\right)$$
$$\Sigma^{-1} \sim \text{Wishart}\left(\left(n\hat{\Sigma}\right)^{-1}, n-m\right)$$

1. Draw covar-matrices $\grave{\Sigma}$ from inverse Wishart with $\hat{\Sigma}$, n and m
2. Cond. on $\grave{\Sigma}$ draw VAR-coefficients $\grave{\beta} \sim N\left(\hat{\beta}, \grave{\Sigma} \otimes (X'X)^{-1}\right)$
3. Use $\grave{\beta}$ to construct $\sum_{\tau}^{\infty} \rho^{\tau-1} \grave{E}_t \Delta l^e_{t+\tau}$, $\sum_{\tau}^{\infty} \rho_t^{\tau-1} \grave{E}_t r^e_{h,t+\tau}$, and $\grave{\psi}_t$
4. Regress $\grave{\psi}_t$, $\sum_{\tau}^{\infty} \rho^{\tau-1} \grave{E}_t \Delta l^e_{t+\tau}$, $\sum_{\tau}^{\infty} \rho_t^{\tau-1} \grave{E}_t r^e_{h,t+\tau}$ on π_t, i_t, $1/i_t$
5. Iterate and compute confidence intervals for *OLS* coefficients and R^2 from their percentiles

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Robustness analysis - Results

DepVar:	Regressors:					
	π_t		i_t		$\log(1/i_t)$	
	coeff.	R^2	coeff.	R^2	coeff.	R^2
Panel A						
$\hat{\psi}_t$	-3.10 [-7.79, $-.19$]	.61 [.03, .92]	-5.28 [-12.63, $-.25$]	.57 [.04, .78]	.107 [.01, .25]	.54 [.04, .71
Δl-terms	-2.6 [-11.8, 9.08]	.27 [0, .85]	-4.01 [-18.1, 13.9]	.20 [0, .64]	.095 [$-.303$, .392]	.21 [0, .58]
$-r$-terms	1.81 [-10.41, 9.61]	.10 [0, .64]	3.44 [-15.34, 15.43]	.09 [0, .59]	$-.048$ [$-.328$, .286]	.07 [0, .44]
Panel B						
$\hat{\varepsilon}_t$	-3.9 [-11.1, $-.19$]	.64 [.05, .94]	-6.28 [-17.4, $-.68$]	.54 [.05, .75]	.129 [.01, .372]	.52 [.05, .67

Table 2: Median and 95 percent confidence intervals for slope coefficients and R^2.

Robustness analysis - Results

DepVar:	Regressors:					
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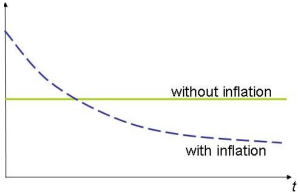
Table 2: Median and 95 percent confidence intervals for slope coefficients and R^2.

1. Money illusion - Related literature
2. U.K. evidence
   - Real versus nominal - A first-cut
   - Decomposing inflation effects
   - Financial frictions
3. Cross-country evidence
   - U.S. evidence
4. Conclusion

Tilt effect of inflation

- inflation *tilts* real mortgage repayment scheme



- can't afford initial mortgage payments Lessard-Modigliani + Tucker (1975)
- BUT more flexible mortgage schemes
  - Price level adjusted mortgage (PLAM)
  - Graduate payment mortgage (GPM)
  - Interest only mortgages

  are available since 1970's in UK and mortgages became more flexible over the years

PREDICTION OF TILT EFFECT:

- inflation effect less negative over time

Tilt effect - Inflation effect over time

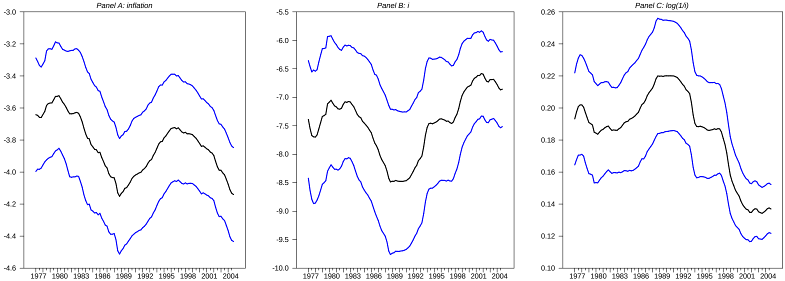


Figure 6: Point estimates and 95 percent Newey and West (1987) corrected confidence bounds of slope coefficients as sample size increases.

- tilt effect is unlikely to explain inflation effect.

Lock-in effect

- locked in low fixed nominal rate on existing mortgage
  $\Rightarrow$ reluctant to buy better house if mortgage is not portable

PREDICTION OF LOCK-IN EFFECT

- for the full sample estimates

$$\psi_t = \hat{a} + \hat{b}_1 d_t i_t + \hat{b}_2 (1 - d_t) i_t + \hat{e}_t \Rightarrow \hat{b}_1 \neq \hat{b}_2$$

  where d_t is an indicator function of upward movements in i_t
- for rolling samples estimates:
  - $\text{Corr}\left[R^2, d_t\right] > 0$
  - $\text{Corr}\left[R^2, i_t\right] < 0$
- Can be rejected!
- Surprising? No, since most mortgages in the UK are portable (and flexible interest rate mortgages)

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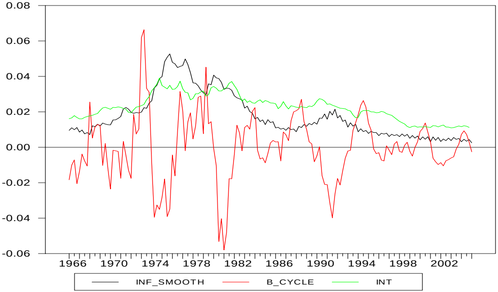
Mispricing measures and the business cycle

- During booms (busts) high quality houses appreciate (de-) more than smaller houses
  - house prices reflect all types of dwellings
  - rent index tends to overweigh lower quality dwellings
- $\Rightarrow$ Price-rent ratio might move over business cycle
- Control for business cycle proxy
  - $\hat{c}_t$ Hodrick-Prescott (1997) filter



Mispricing measures and the business cycle

Row:	DepVar:	Regressors: $\hat{c}_t$	π_t	i_t	$\log(1/i)$	R^2
(1)	$\hat{\psi}_t$	0.81 (1.959)				.07
(2)		0.32 (2.135)	−4.00 (13.761)			.85
(3)		0.378 (2.168)		−6.64 (11.137)		.76
(5)	$\hat{\psi}'_t$	1.11 (0.963)				.01
(6)		0.36 (0.349)	−5.98 (2.279)			.17
(7)		0.41 (0.369)		−10.5 (2.436)		.17
(9)	$\hat{\varepsilon}_t$	0.85 (2.201)				.07
(10)		0.41 (2.281)	−3.80 (7.801)			.67
(11)		0.49		−6.10		.57

U.S. Decomposition of inflation effects

Dependent Variables:	Regressors: π_t coeff.	R^2	i_t coeff.	R^2	$\log(1/i_t)$ coeff.	R^2
Panel A						
$\hat{\psi}_t$	-6.65 (4.525)	.45	-6.30 (3.182)	.28	.141 (4.256)	.35
$\sum_{\tau=1}^{\infty} \rho^{\tau-1} \hat{E}_t \Delta l^e_{t+\tau}$	-2.87 (6.572)	.65	-3.46 (6.170)	.65	.066 (4.693)	.60
$-\sum_{\tau=1}^{\infty} \rho^{\tau-1} \tilde{E}_t r^e_{h,t+\tau}$	.76 (.211)	.01	4.65 (1.130)	.05	$-.066$ (.734)	.03
Panel B						
$\hat{\varepsilon}_t$	-10.2 (5.148)	.48	-6.86 (2.648)	.15	.159 (3.238)	.21

Table 3: Univariate Regressions, Newey-West (1987) corrected t-statistics in brackets.

U.S. Robustness analysis

DepVar:	Regressors:					
	π_t		i_t		$\log(1/i_t)$	
	coeff.	R^2	coeff.	R^2	coeff.	R^2
Panel A						
$\hat{\psi}_t$	-6.06 $[-7.32, -2.76]$	.44 [.06, .66]	-5.84 $[-7.12, -2.14]$	.27 [.03, .66]	.130 [.070, .155]	.35 [.06, .60]
ΔI-terms	-2.86 $[-8.17, 1.53]$	.59 [.01, .96]	-3.45 $[-7.27, -0.53]$	.52 [.02, .71]	.066 [.003, .149]	.51 [.01, .70]
$-r$-terms	.44 $[-4.84, 3.21]$	.01 [0, .09]	4.23 [1.12, 5.82]	.04 [.01, .12]	$-.023$ $[-.097, 0]$	.07 [0, .15]
Panel B						
$\hat{\varepsilon}_t$	-10.2 $[-16.2, -7.25]$	.48 [.36, .62]	-6.83 $[-10, -4.79]$	.15 [.11, .21]	.159 [.115, .25]	.21 [.16, .26]

Table 4: Median and 95 percent confidence intervals for slope coefficients and R^2.

Conclusion

- Money Illusion arises if e.g. investors simply compare current rent with current mortgage payment
- Inflation affects house prices
- Rational channels alone do explain inflation effects
  - Low inflation leads to higher *expected rent growth*
  - Inflation impact on *expected housing returns* is insignificant
  - Inflation explains substantial part of *"mispricing"*
- Frictions are unlikely to fully rationalize the empirical findings
  - *Tilt effect* should decline as mortgages became more flexible
  - *Lock-in effect* does not arise since mortgages are portable in UK
- $\Rightarrow$ Evidence in favor of money illusion
- Money illusion and mortgage markets have important implications for monetary economics

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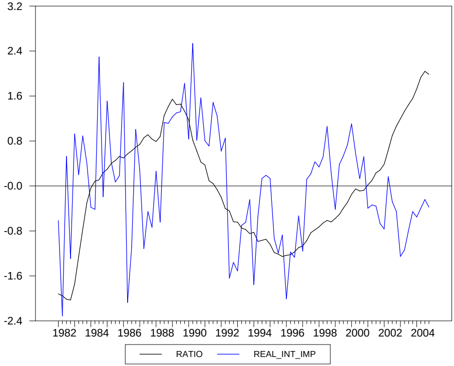
First difference estimation

	Slope coeff.	R^2
U.K	-4.022 (7.459)	.31
U.S.	-3.629 (6.588)	.35
Australia	-26.21 (25.82)	.85

Price-rent ratio and implied real interest rates



(standardized series)

Mispricing measures and the business cycle

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