Stock Market Fluctuations: The role of macroeconomic fundamentals, habit and heterogeneous beliefs.

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BI Norwegian Business School

BI - Kleivia Research Meeting

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Motivation

- Volatility puzzle of Shiller (1981) and Leroy and Porter (1981).
  - Stock market fluctuations are too high, compared to variations in the present value of future dividends, if discount rates are constant.
- Price-dividend ratio variance decomposition by Cochrane (1992)
  - Bulk of stock market fluctuations due to changes in discount rates, which must have unusual characteristics.
- Lettau, Ludvigson and Wachter (2008)
  - The unusual rise in the stock-market during the 1990s was due to a decline in equity premium (discount rate), because of a decline in macroeconomic risk.

Shiller: Irrational Exchuberance

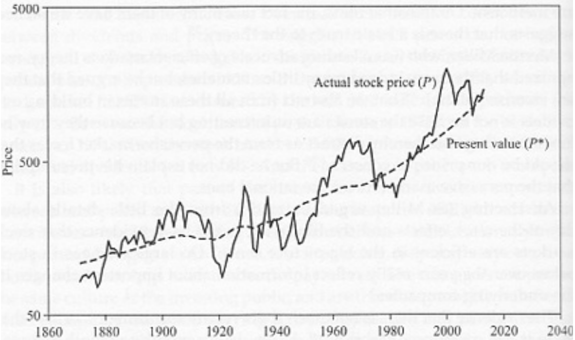
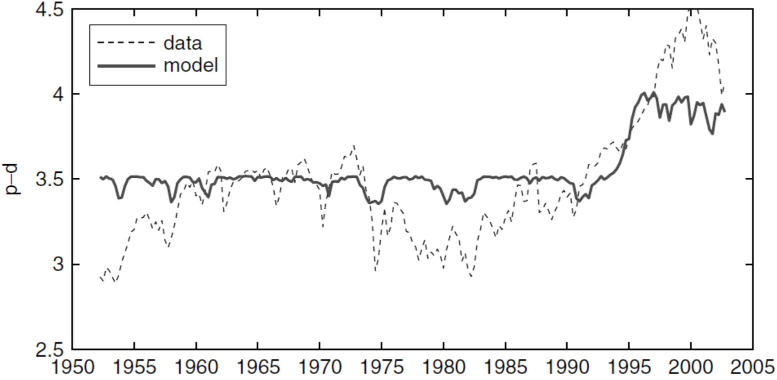


Figure 11.2

Stock Prices and Dividend Present Values, 1871–2013

Lettau, Ludvigson and Wachter (2008)

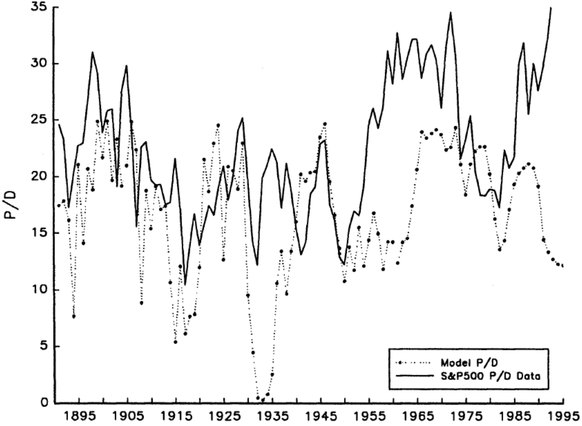
Structural shift in macroeconomic risk.



Equilibrium asset pricing theories

- Campbell and Cochrane (1999): Time-varying risk-aversion from habit-formation preferences (Sundaresan (1989), Constantinides (1990))
- Bansal and Yaron (2004): Small and persistent changes in expected consumption growth with Epstein and Zin (1989, 1991) and Weil (1989) preferences.
- Rare disasters (Barro (2006)) with varying disaster probability (Gabaix (2012), Wachter (2013))
- Lettau, Ludvigson and Wachter (2008): Time-varying macroeconomic risk

Campbell and Cochrane (1999)



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  - Macroeconomic uncertainty does not seem to matter.
  - A decline in heterogeneous beliefs captures well the increase in prices during the 1990s

Model without heterogeneous beliefs

Model with heterogeneous beliefs

Other related literature

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- The equity premium puzzle (Mehra and Prescott (1985))
  - Fama and French (2002), Soderlind (2009)

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$$\mu_t \mid \mathcal{F}_t \sim N(\mu_t^i, u_t^2)$$

- For each agent the conditional uncertainty about next periods aggregate consumption growth is given by

$$g_{t+1} \mid \mathcal{F}_t \sim N(\mu_t^i, \sigma_t^2 + u_t^2)$$

The model: Preferences

- Agents have identical (multiplicative) habit formation preferences

$$U_i(c, X) = \mathbb{E}_0^i \left[\sum_{t \in \mathbb{N}} \delta^t u(c_t, X_t) \right]$$

where

$$u(c, X) = \frac{c^{1-\gamma}}{1-\gamma} X^{\gamma-\eta}$$

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- X denotes the common external habit, the log of which follows the process

$$x_{t+1} = \lambda_x x_t + (1 - \lambda_x) y_t$$

  where $\lambda_x \in (0, 1)$ and y denotes the log aggregate consumption.

Homogeneous beliefs: Beliefs

- Let us consider first the case of no heterogeneity where agents have some form of adaptive beliefs

$$
\begin{aligned}
\mu_{t+1} &= \lambda_\mu \mu_t + (1-\lambda_\mu) g_{t+1}, \\
\sigma^2_{t+1} &= \lambda_\sigma \sigma^2_t + (1-\lambda_\sigma)(\mu_t - g_{t+1})^2.
\end{aligned}
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- The uncertainty about the conditional mean, consistent with Bayesian updating (of a random walk process) and the previous assumption, is as follows

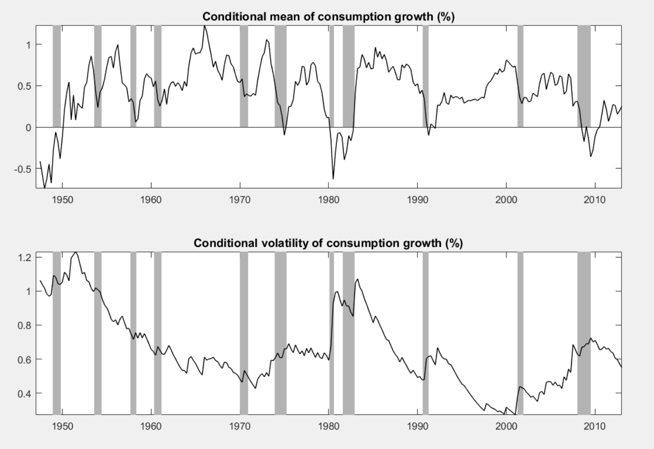
$$\lambda_\mu = \frac{\sigma^2_t}{\sigma^2_t + u^2_t}, \qquad \Rightarrow \qquad u_t = \sigma_t \sqrt{\frac{1}{\lambda_\mu} - 1}$$

Consumption growth process estimation

Unconstrained (quasi)-maximum likelihood estimation

	μ_0	σ_0	λ_μ	λ_σ	$\ln L$
g	-0.4131	1.0627	0.7840	0.9098	-955.6165
	(0.6520)	(0.3015)	(0.0614)	(0.0216)	-

Fitted mean and volatility of consumption growth



Homogeneous beliefs: Asset prices

- The stochastic discount factor is as follows:

$$M_{t,t+1} = \delta \exp\left[-\gamma g_{t+1} + (1-\lambda_x)(\gamma-\eta)\omega_t\right].$$

under the common beliefs

$$g_{t+1} \sim N\left(\mu_t, \frac{1-\lambda_\mu}{\lambda_\mu}\,\sigma_t^2\right)$$

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- The risk-free rate

$$r_t^f = -\log(\delta) + \gamma\mu_t - (1-\lambda_x)(\gamma-\eta)\omega_t - \frac{1}{2}\gamma^2\sigma_t^2\frac{1-\lambda_\mu}{\lambda_\mu}.$$

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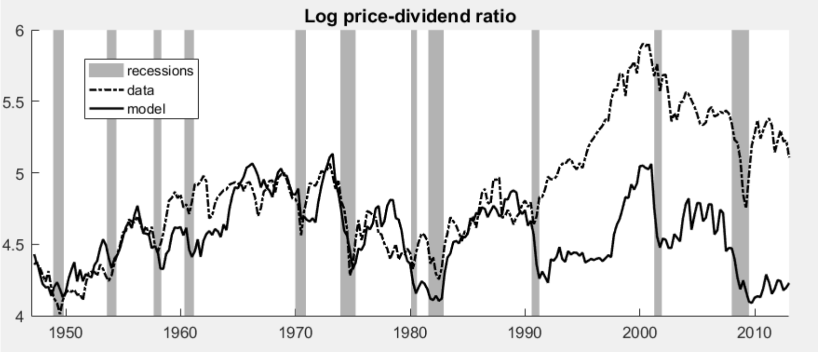
- The stock market is the claim to the aggregate consumption.

Homogeneous beliefs: Fitted asset prices



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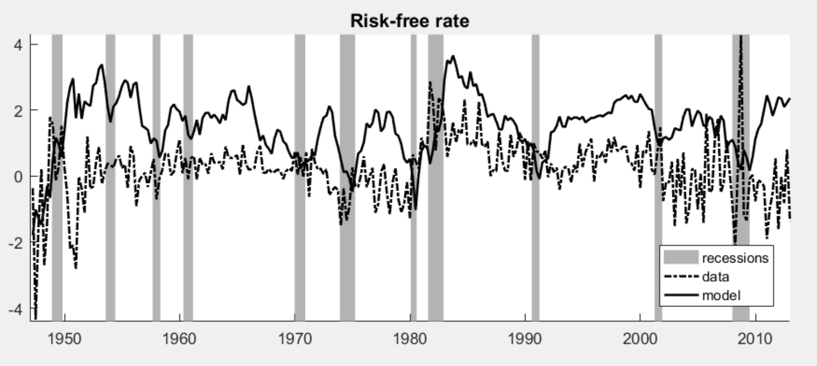

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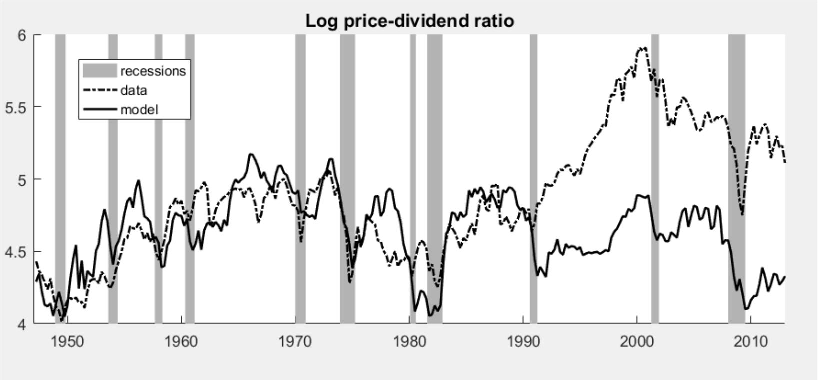

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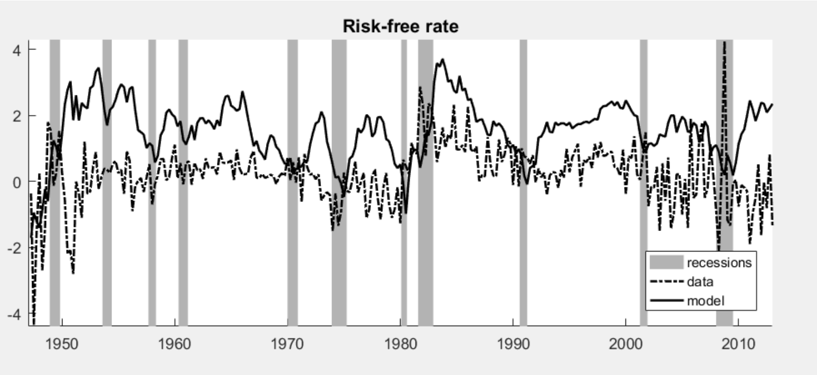

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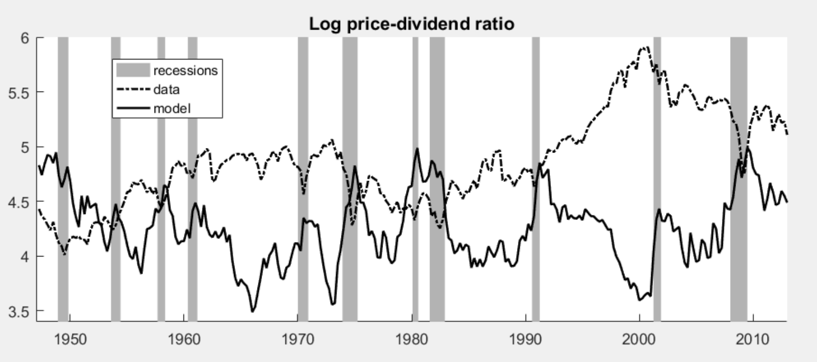

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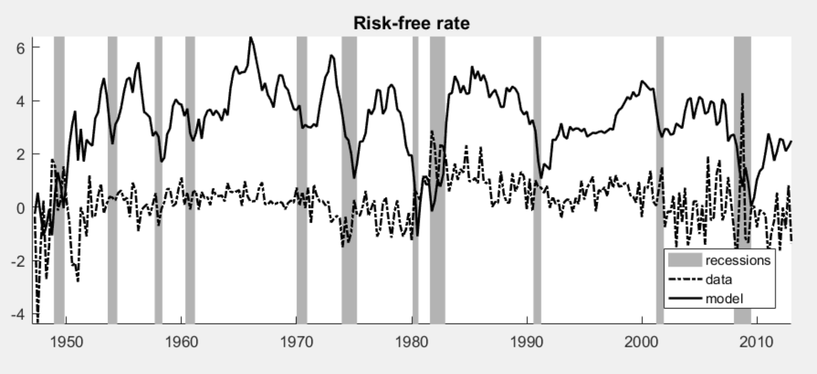
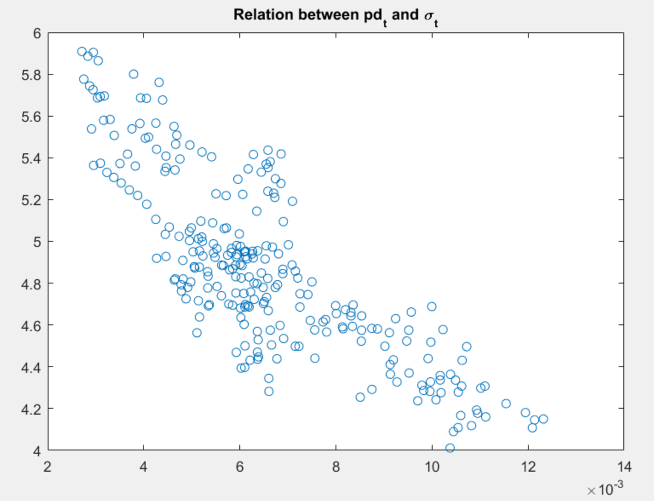


Empirical relation: pd_t vs fitted σ_t

Correlation = -0.81



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- Individual beliefs differ from the “mean beliefs”

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- The (consumption weighted) average beliefs are the same as in the homogeneous economy (unbiased)

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- The heterogeneity is captured by the cross-section variation in beliefs

$$\nu_t^2 = \int \alpha_t^i (\mu_t^i - \mu_t)^2 di$$

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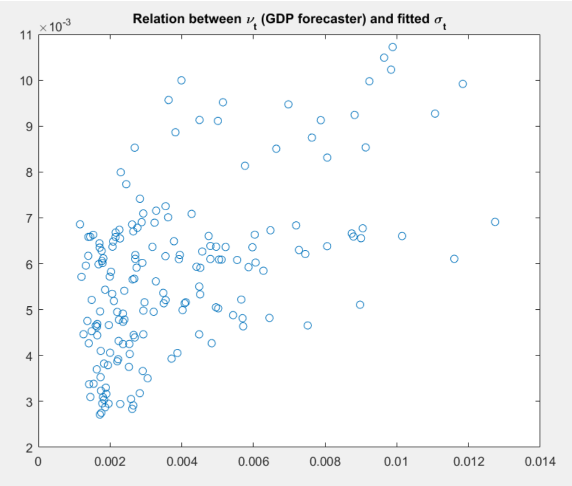
- The cross-sectional heterogeneity is a function of uncertainty

$$\log(\nu_t) = \kappa_0 + \kappa_1 \log(\sigma_t)$$

Empirical relation between ν and fitted σ

Cross-sectional heterogeneity in GDP forecasts by professional forecasters (Philadelphia Fed). Relation: $y = -0.57 + 0.99\,x + e$.



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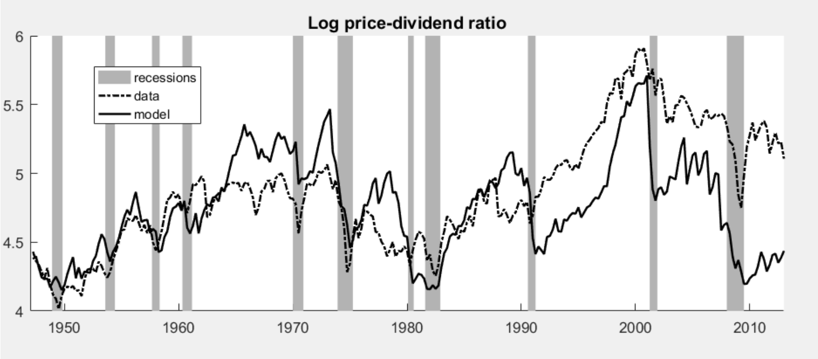
Heterogeneous beliefs: Fitted asset prices



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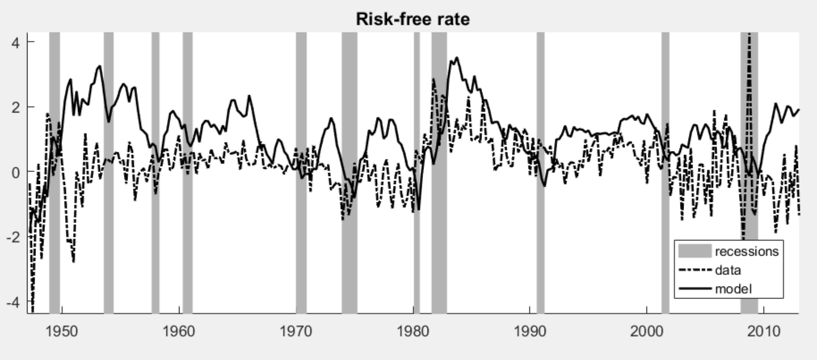
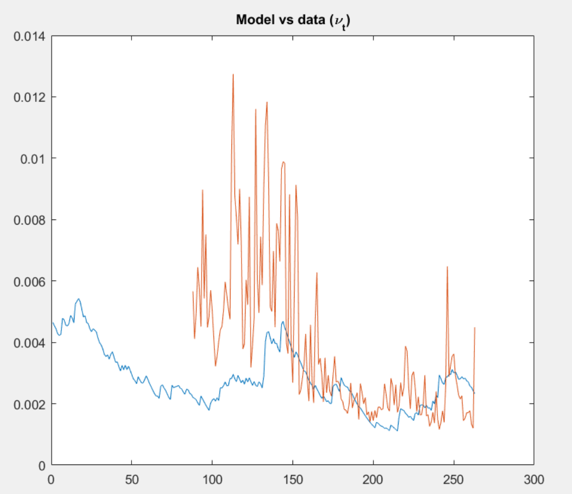


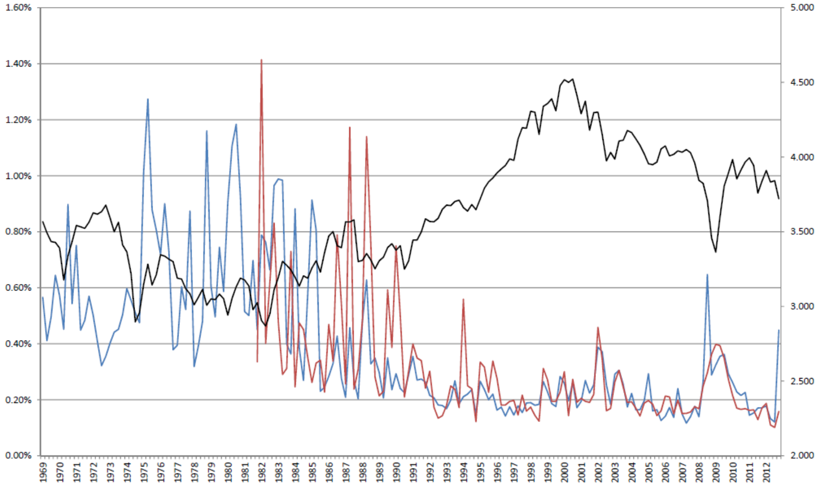
Relation between model heterogeneity and data



Asset pricing moments

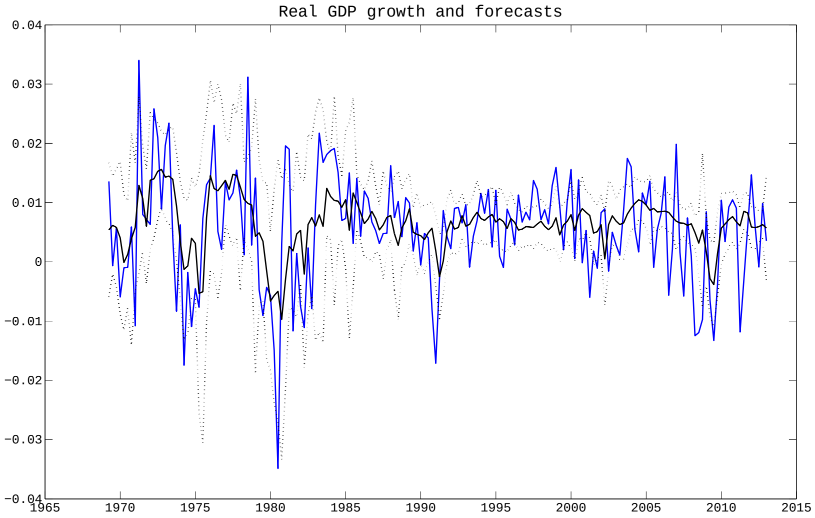
	Data	Hom (all)	Hom (-σ_t)	Data (-ω_t)	Het (all)
$\mu(pd)$	4.87	4.56	4.63	4.26	4.76
$\sigma(pd)$	0.42	0.25	0.26	0.33	0.36
$ac_1(pd)$	0.98	0.95	0.94	0.92	0.96
$\rho(pd, pd^d)$	-	0.33	0.24	-0.36	0.57
$\mu(r_f)$	0.22	1.53	1.54	3.16	1.15
$\sigma(r_f)$	0.93	0.89	0.89	1.39	0.90
$ac_1(r_f)$	0.35	0.89	0.89	0.90	0.90
$\rho(r_f, r_f^d)$	-	0.14	0.14	0.07	0.13
$\rho(pd, r_f)$	0.05	0.28	0.38	-0.95	0.09
$\mu(r_m)$	1.67	1.61	1.60	1.94	1.51
$\sigma(r_m)$	8.35	8.54	9.26	12.63	10.28
$\mu(r_m - r_f)$	1.45	0.08	0.07	-1.23	0.36
$\sigma(r_m - r_f)$	8.29	8.46	9.19	12.35	10.18

Forecast dispersion and stock prices (corr = −0.68)



Conclusions

Mean and dispersion in analysts' forecasts (Phil. Fed)



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