Interpretable asset markets

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October 13, 2017

Outline

Motivation

- An often discussed but not verified view: The **aggregate economic uncertainty** has sizable effects on **asset valuations** and financial markets **dislike economic uncertainty.**
- Information regarding future expected growth might be encoded in current asset valuation.

Literature Review

- A rise in economic uncertainty increases expected returns and leads to a fall in asset valuations. A rise in expected growth, on the other hand leads to a rise in asset valuations. Both these effects can be interpreted from the perspective of general equilibrium models (e.g., Bansal and Yaron, 2004).
- Asset markets "shuts-off" the channels of expected growth rates and economic uncertainty, as growth rates are assumed to be i.i.d. (e.g., Campbell and Cochrane, 1999; Cechetti et al., 2000).

The economy and asset valuation

- Using the Campbell and Shiller(1988) approximation to write the log valuation ratio.

$$p_t - y_t = \kappa_t + E_t \sum_{j=1}^{\infty} \kappa_1^j [g_{y,t+j} - r_{t+j}] \tag{1}$$

where p_t is the log of the stock price, y_t is the log-level of cash-flows, $g_{y,t+1}$ is the growth rate of market cash-flows, and r_{t+1} is the continuously compounded return on the market portfolio.

- An additional accounting implication of the above present value restriction is:

$$var(p_t - y_t) = \sum_{j=1}^{\infty} \kappa_1^j [cov(g_{y,t+j} - y_t) \tag{2}$$

The economy and asset valuation (Cont'd)

- Following this intuition, the main focus of this paper is in exploring the links between fundamental economic uncertainty and asset valuation. Consider the following projections:

$$E_t[r_{t+1}] = r_f + \gamma\sigma_{c,t}^2 \tag{3}$$

  where γ capture attitudes toward risk governed by preferences and technology in the economy Substituting the expression for expected returns is Eq. (3) into Eq. (1) implies that a rise in anticipated consumption volatility should lower asset valuations, $p_t - y_t$.

The economy and asset valuation (Cont'd)

- In a variety of models, expected returns are determined by the conditional volatility of aggregate consumption, that is

$$p_t - y_t = b_0 + b_\sigma \sigma_{c,t-1} + u_{1,t} \tag{4}$$

  where $\sigma_{c,t-1}$ ia a measure of consumption volatility as of time $t-1$. A negative b_σ in the above projection indicates that financial markets dislike economic uncertainty.

The economy and asset valuation (Cont'd)

- substituting the expression for the expected returns (Eq. (3)) into Eq. (2). If consumption volatility is time varying and is important for explaining expected returns then $p_t - y_t$ should also predict *future* consumption volatility. Hence, consider the following additional projection:

$$|\eta_{c,t+J}| = \alpha_0 + \alpha_{1,J}(p_t - y_t) + u_{2,t+J}, \qquad J \leq 1 \tag{5}$$

where $|\eta_{c,t+J}|$ is the one step-ahead innovation in the consumption growth at date t + J. If volatility is long-lasting then current valuation rations should be able to predict future realized consumption volatility, and $\alpha_{1,J}$ should be different from zero. Further, if financial markets dislike economic uncertainty, and the volatility process is persistent, then $\alpha_{1,J}$ should be negative as well.

Approach and Findings

1. regressing $p_t - y_t$ on to $\sigma_{c,t-1}$ produces sizeable negative slope coefficients and significant R^2s
2. future (realized) economic uncertainty, $|\eta_{c,t+J}|$ is predicted by $p_t - y_t$, with negative slope coefficients
3. current $p_t - y_t$ predicts future growth rates, $g_{y,t+J}$, with a positive slope coefficient.

Data: quarterly data of US spanning the period 1949.1-1999.4 (from CRSP and NIPA)

Summary Statistics: USA(quarterly)

Table: Summary Statistics: USA (quarterly)

	$E(\cdot)$	$\sigma(\cdot)$	$corr(g_c, g.)$	$AC(4)$	$AC(8)$
USA(1949.1 - 1999.2)					
g_c	0.008	0.005		0.009	-0.128
g_d	0.005	0.017	0.11	-0.037	-0.023
g_e	0.002	0.068	0.31	-0.094	-0.159
r_m	0.021	0.078		0.002	-0.032
$(p-d)$	3.333	0.317		0.768	0.594
$((p-e)$	2.203	0.422		0.781	0.576
USA(1972.1 - 1998.2)					
g_c	0.007	0.005		0.034	-0.194
g_d	0.004	0.015	0.16	-0.183	0.078
g_e	0.004	0.064	0.32	0.054	-0.257
r_m	0.019	0.082		-0.016	-0.029
$(p-d)$	3.340	0.295		0.680	0.496
$(p-e)$	2.247	0.343		0.706	0.509

g_c, g_d, and g_e deonote respectively the real growth rate of consumption, dividends, and earings. r_m is the real return on the market portfolio. $p-d$ and $p-e$ denote the log price-dividend and price-earnings, respectively. $E(\cdot)$ and $\sigma(\cdot)$ denote the mean and standard deviation, and $AC(j)$ is the jth autocorrelation.

Two Measures of Economic Uncertainty

Two Measures of Economic Uncertainty

1. $\sigma_{c,t-1,J} = log(\sum_{j=1}^{J} |\eta_{c,t-j}|)$ (Anderson et al. 2003) where $\eta_{c,t}$ is the innovation in consumption growth.
2. $\sigma_{c,t}$ which is based on modelling consumption growth as following an AR(1)-GARCH(1,1).

regression models

- $$g_{c,t} = \mu + A_1 g_{c,t-1} + \eta_{c,t} \tag{6}$$

- $$g_{c,t} = \mu + A_1 g_{c,t-1} + \eta_{c,t}$$

$$\sigma^2_{c,t} = \omega_0 + \omega^2_{c,t-1} + \omega_2 \sigma^2_{c,t-1} \tag{7}$$

Consumption growth and market return projection (quarterly)

Table: Consumption growth and market return projection (quarterly)

	μ	A_1	ω_0	ω_1	ω_2		AC(1)	AC(4)	AC(8)
AR(1) estimates									
Panel A: Consumption growth									
Estimate	0.007	0.234				Estimate	0.174	0.088	0.049
S.E.	0.001	0.080				Q-stat	6.20	17.73	30.76
Panel B: Market return									
Estimate	0.020	0.066				Estimate	0.108	0.071	-0.083
S.E.	0.006	0.079				Q-stat	2.39	9.61	16.20
AR(1)-GARCH(1,1) estimates									
Panel C: Consumption growth									
Estimate	0.007	0.310	1.63*	0.143	0.788				
S.E.	0.001	0.076	1.68*	0.073	0.091				
Panel D: Market return									
Estimate	0.002	0.090	0.002	0.139	0.541				
S.E.	0.006	0.078	0.001	0.118	0.166				

Economic uncertainty predicting future valuation ratios: USA

$$p_t - y_t = b_0 + b_{\sigma,J}\sigma_{c,t-1,J} + \mu_{1,t}$$

Table: Economic uncertainty predicting future valuation ratios: USA

J	Regressor $\sigma_{c,t-1,J}$					
	Data			Monte-Carlo		
	$b_{\sigma,J}$	t-stat	$\bar{R}^2$	$t(2.5\%)$	$t(2.5\%)$	$\bar{R}^2(95\%)$
Panel A: Price dividend ratio						
1	-0.084	-2.614	0.08	-1.870	-1.496	0.04
4	-0.254	-3.703	0.19	-3.873	-3.197	0.16
8	-0.358	-3.153	0.26	-4.024	-3.256	0.25
Panel B: Price earnings ratio						
1	-0.111	-2.428	0.08	-1.826	-1.435	0.04
4	-0.364	-4.053	0.23	-3.708	-3.047	0.15
8	-0.489	-4.398	0.33	-3.778	-3.111	0.23

Economic uncertainty predicting future valuation ratios: USA

$$p_t - y_t = b_0 + b_{\sigma,J}\sigma_{r_m,t-1,J} + \mu_{1,t}$$

Table: Economic uncertainty predicting future valuation ratios: USA

J	Regressor $\sigma_{r_m,t-1,J}$					
	Data			Monte-Carlo		
	$b_{\sigma,J}$	t-stat	$\bar{R}^2$	$t(2.5\%)$	$t(2.5\%)$	$\bar{R}^2(95\%)$
Panel A: Price dividend ratio						
1	-0.049	-2.274	0.03	-1.546	-1.232	0.02
4	-0.088	-1.275	0.02	-2.733	-2.266	0.09
8	-0.135	-1.348	0.03	-2.998	-2.474	0.16
Panel B: Price earnings ratio						
1	-0.026	-0.446	0.00	-1.521	-1.214	0.02
4	-0.000	-0.001	0.00	-2.669	-2.268	0.08
8	-0.019	-0.150	0.00	-2.913	-2.430	0.14

PICTURE

Left: $\sigma_{c,t-1,12}$ versus $(p_t - e_t)$
Right: $e_t - e_{t-12}$ versus $p_t - e_t$
All variables are standardized.

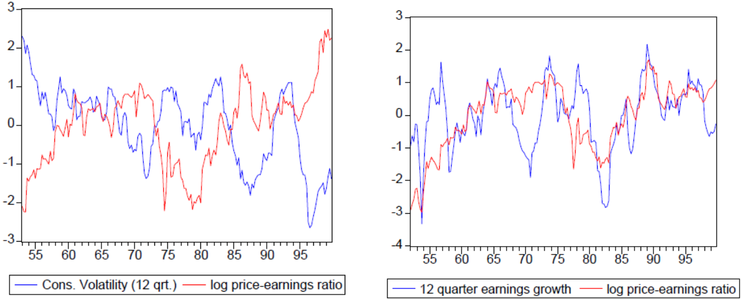

Figure: Fig.1

Valuation ratios predicting future economic uncertainty: USA

Table: Valuation ratios predicting future economic uncertainty: USA

J	Predicting $\lvert\eta_{c,t+J}\rvert$					
	Data			Monte-Carlo		
	$\alpha_{1,J}$	t-stat	$\bar{R}^2$	$t(2.5\%)$	$t(2.5\%)$	$\bar{R}^2(95\%)$
Panel A: Price dividend ratio						
1	-1.012	-4.027	0.08	-3.200	-2.661	0.04
4	-0.788	-3.064	0.04	-3.059	-2.553	0.04
8	-0.796	-3.13	0.04	-3.035	-2.501	0.04
Panel B: Price earnings ratio						
1	-0.806	-4.899	0.1	-3.121	-2.602	0.04
4	-0.629	-3.772	0.05	-3.066	-2.53	0.04
8	-0.594	-3.59	0.04	-3.062	-2.518	0.04

Valuation ratios predicting future economic uncertainty: USA

Table: Valuation ratios predicting future economic uncertainty: USA

J	Predicting $\lvert\eta_{r_m,t+J}\rvert$					
	Data			Monte-Carlo		
	$\alpha_{1,J}$	t-stat	$\bar{R}^2$	$t(2.5\%)$	$t(2.5\%)$	$\bar{R}^2(95\%)$
Panel A: Price dividend ratio						
1	-0.592	-1.760	0.02	-2.322	-1.929	0.02
4	-0.194	-0.549	0.00	-2.353	-1.935	0.02
8	0.117	0.330	0.00	-2.434	-1.997	0.02
Panel B: Price earnings ratio						
1	-0.154	-0.713	0.00	-2.378	-1.976	0.02
4	-0.034	-0.154	0.00	-2.392	-1.985	0.02
8	-0.017	-0.087	0.00	-2.465	-2.053	0.02

regression function

To account for the persistence is variables we also include distributed lags of the dependent variable in our projections.

- $$p_t - e_t = \alpha_{1,0} + \alpha_{1,1}(p_{t-1} - e_{t-1}) + \alpha_{1,2} log\sigma^2_{c,t-1} + \epsilon_{1,t} \tag{8}$$

- $$log\sigma^2_{c,t} = \alpha_{2,0} + \alpha_{2,1}(p_{t-1} - e_{t-1}) + \alpha_{2,2} log\sigma^2_{c,t-1} + \epsilon_{2,t} \tag{9}$$

Price - earnings ratios and economic uncertainty: USA

Table: Price - earnings ratios and economic uncertainty: USA

	Data			Monte-Carlo			
	Est.	t-stat	$\bar{R}^2$	$t(2.5\%)$	$t(5\%)$	$\bar{R}^2(95\%)$	$\bar{R}^2(97.5\%)$
Panel A: Predicting price earnings ratio							
$p_t - e_t = \alpha_0, +\alpha_1 log\sigma^2_{c,t-1} + \epsilon_t$							
α_1	-0.503	-5.08	0.34	-2.93	-2.4	0.22	0.28
$p_t - e_t = \alpha_{1,0}, +\alpha_{1,1}(p_{t-1} - e_{t-1}) + \alpha_{1,2} log\sigma^2_{c,t-1} + \epsilon_{1,t}$							
$\alpha_{1,2}$	-0.035	-2.08	0.94	-1.78	-1.5	0.96	0.97
$\alpha_{1,1}$	0.937	40.32					
Panel B: Predicting volatility							
$log\sigma^2_{c,t}, = \alpha_0, +\alpha_2(p_{t-1} - e_{t-1}) + \epsilon_t$							
α_2	-0.705	-4.6	0.36	-2.45	-2.05	0.23	0.29
$log\sigma^2_{c,t}, = \alpha_{2,0}, +\alpha_{2,1}(p_{t-1} - e_{t-1}) + \alpha_{2,2} log\sigma^2_{c,t-1} + \epsilon_{2,t}$							
$\alpha_{2,1}$	-0.128	-2.95	0.84	-1.55	-1.34	0.93	0.94
$\alpha_{2,2}$	0.856	26.67					

Two predictability projection

Growth-rate predictability projection:

$$\sum_{l=1}^{L} g_{y,t+l} = \beta_0 + \beta_{1,L}(p_t - y_t) + u_{t+L}, \qquad L \leq 1, \tag{10}$$

and the companion return projection

$$\sum_{l=1}^{L} r_t + l = \beta_0 + \beta_{1,L}(p_t - y_t) + u_{t+L}, \qquad L \leq 1. \tag{11}$$

Valuation ratios predicting future growth rates and returns: USA

Table: Valuation ratios predicting future growth rates and returns: USA

J	Predicting $\sum_{l=1}^{L} g_{c,t+l}$			Predicting $\sum_{l=1}^{L} g_{d,t+l}$			Predicting $\sum_{l=1}^{L} r_{m,t+l}$		
	$\beta_{1,J}$	$t-stat$	$\bar{R}^2$	$\beta_{1,J}$	$t-stat$	$\bar{R}^2$	$\beta_{1,J}$	$t-stat$	$\bar{R}^2$
Panel A: Price dividend ratio									
4	0.059	0.802	0.01	0.001	0.0540	0.00	-0.139	-2.071	0.06
8	0.120	0.819	0.02	-0.015	-0.462	0.00	-0.256	-2.102	0.11
12	0.237	1.366	0.07	-0.041	-1.327	0.01	-0.366	-1.931	0.15
16	0.325	1.333	0.11	-0.084	-1.941	0.03	-0.494	-1.846	0.20
Panel B: Price earnings ratio									
4	0.095	1.485	0.06	-0.017	-0.971	0.01	-0.074	-1.533	0.03
8	0.195	1.650	0.14	-0.027	-0.937	0.01	-0.149	-1.646	0.07
12	0.287	2.284	0.23	-0.036	-1.31	0.02	-0.195	-1.521	0.09
16	0.350	2.071	0.31	-0.058	-1.649	0.04	-0.272	-1.586	0.15

Valuation ratios predicting future growth rates and returns

Our main point is that, empirically, dividends behave very differently from earnings. The results for predicting dividend growth (middle columns) replicate what is found in the literature¡ªthat is dividend growth is not predictable by price¨Cdividend ratios. This is also true for trying to predict dividend growth using price¨Cearnings ratio. Earnings growth, however, is predicted by price¨Cdividend ratios, and in a sizable and significant manner by price¨Cearnings ratios (left columns).

Price - earnings ratio and growth rates

Table: Price - earnings ratio and growth rates

J	Data			Monte Carlo			
	$\beta_{1,J}$	$t - stat$	$\bar{R}^2$	$t(90\%)$	$t(95\%)$	$t(97.5\%)$	$\bar{R}^2(95\%)$
$sum_{l=1}^{L} g_{e,t+l} = \beta_0 + \beta_{1,L}(p_t - e_t)$							
4	0.095	1.485	0.06	1.609	2.033	2.425	0.07
8	0.195	1.65	0.14	1.638	2.115	2.506	0.13
12	0.287	2.284	0.23	1.733	2.194	2.615	0.2
16	0.35	2.071	0.31	1.79	2.274	2.709	0.27

For each horizon, these R^2 are significantly smaller than the corresponding $R^2 s$ for predicting future earnings growth. A common view, driven by the focus on price $-$ dividend ratios, is that fluctuations in cost of capital and not in cash flows are the key for explaining fluctuations in asset valuations. In fact, Cochrane (1992) and Campbell and Cochrane (1999) advocate that about 100% (or more) of the fluctuations in price¨Cdividend ratios are attributable to cost of capital.

Conclusion

In this paper we show that measures of economic uncertainty (conditional volatility of consumption) predicts and is predicted by valuation ratios at long horizons. We show that asset valuations drop as economic uncertainty rises that is, financial markets dislike economic uncertainty. Moreover, long horizon R^2s from predicting future economic growth (earnings growth) are fairly high for the US price earnings ratios.