

The Habit Habit

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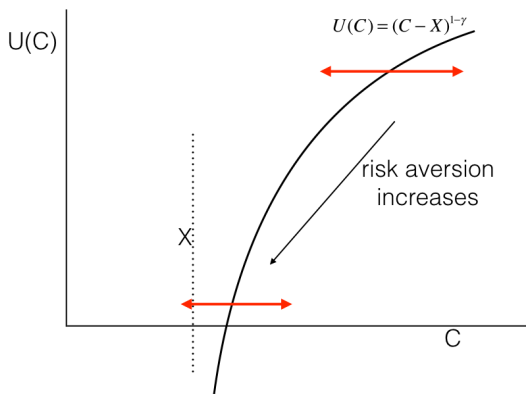
Hoover Institution, Stanford University and NBER

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Habits

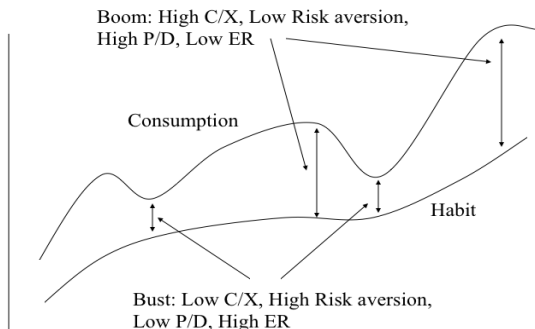
$$u(C) = (C - X)^{1-\gamma} \rightarrow -\frac{u''(C)}{Cu'(C)} = \gamma \left(\frac{C}{C - X} \right) = \frac{\gamma}{S}$$

As C (or S) declines, risk aversion rises.



Habits

Slow-moving habit. Roughly, $X_t \approx \sum \phi^j C_{t-j}$; $X_t \approx \phi X_{t-1} + C_t$



→ Time-varying, recession-driven, risk premium drives return predictability from p/d ; “excess” volatility, much else (correlation, CAPM vs CCAPM, volatility, etc.). “Bubble” story.

Habits



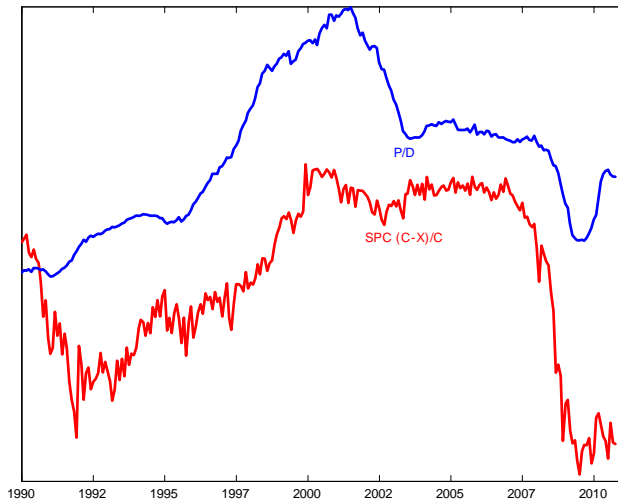
$$u'(C) = (C - X)^{-\gamma}$$

- ▶ Precautionary savings offset intertemporal substitution.
- ▶ Expected returns and fear/hunger. Habits add S = fear that stocks fall in recession

$$1 = E_t(M_{t+1}R_{t+1}); E(R_{t+1}^e) = -cov(R_{t+1}^e, M_{t+1})$$

$$M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(\frac{S_{t+1}}{S_t} \right)^{-\gamma}$$

Habits – latest data



Here, $X_t = k \sum_{j=0}^{\infty} \phi^j C_{t-j}$

Habits – successes and ... directions for improvement

- ▶ Yes: Equity premium, low $\sigma(\Delta c)$, unpredictable Δc , low and constant (or slow varying) risk free rate.
- ▶ No: ... and low risk aversion.
- ▶ Yes: return predictability, p/d volatility, $\sigma(R)$ volatility, long run equity premium.

$$M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(\frac{S_{t+1}}{S_t} \right)^{-\gamma}$$

- ▶ Needed:

The Standard VAR

$$r_{t+1} \approx 0.1 \times dp_t + \varepsilon_{t+1}^r$$

$$\Delta d_{t+1} \approx 0 \times dp_t + \varepsilon_{t+1}^d$$

$$dp_{t+1} \approx 0.94 \times dp_t + \varepsilon_{t+1}^{dp}$$

$\text{cov}(\varepsilon\varepsilon')$		r	Δd	dp
	r	$\sigma = 20\%$	+big	-big
	Δd		$\sigma = 14\%$	0 not -1
	dp			$\sigma = 15\%$

- ▶ Needed: Two shocks! Data $\varepsilon^d, \varepsilon^{dp}$ uncorrelated. Δc is both a cashflow and a discount rate shock.
- ▶ Δd shock in model has less correlation. Match VAR? d, c need to be cointegrated.

(Identities)

- ▶ Note: Δd , dp carry all information

$$r_{t+1} \approx dp_t - \rho dp_{t+1} + \Delta d_{t+1}$$

$$b_r = 1 - b_{dp} + b_d$$

$$\varepsilon_{t+1}^r = -\varepsilon_{t+1}^{dp} + \varepsilon_{t+1}^d$$

Habits – successes and ... directions for improvement

- ▶ Needed: More state variables (?)

1. Empirical

$$R_{t+1}^i = a_i + b_i x_t + c_i y_t + \dots \varepsilon_{t+1}^i; \quad E_t(R_{t+1}^i) = a_i + b_i x_t + c_i y_t$$

How many state variables – independent linear combinations of x, y, z are there? Factor analysis of $\text{cov}(E_t(R_{t+1}^i))$? Across stocks, bonds, fx, etc? (For example, one factor for all bonds.) For mean and variance (separate?)

2. Theoretical: If more than 1, need more state variables (S) in the model!
- ▶ Test; Other assets, $1 = E(mR^{ei})$? Cross section (treating time aggregation right)?
 - ▶ But, warning, all explicit models fail $R^2 = 1$ tests.
 - ▶ Still low hanging fruit for *all* similar models.

Other directions

- ▶ A sampling
 1. Recursive utility (Epstein-Zin)
 2. Long run risks (e.g. Bansal Yaron)
 3. Idiosyncratic risk (e.g. Constantinides and Duffie)
 4. Rare Disasters (e.g. Reitz; Barro)
 5. Nonseparable across goods (e.g. Piazzesi Schneider, housing)
 6. Leverage; balance-sheet; “institutional” (e.g. Brunnermerier, ..)
 7. Ambiguity aversion, min-max, (Hansen and Scheinkman)
 8. Behavioral finance; probability mistakes. (e.g. Shiller, Thaler)
 9. Many others
- ▶ Great unity of theoretical ideas.

$$M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(\frac{Y_{t+1}}{Y_t} \right)^{\theta}$$
$$P_t U'(C) = \beta \sum_s \pi_s(Y?) U'(C_s) X_s$$

Y varies with business cycle. “Fear of Y ” drives asset prices.
(Probability = marginal utility)

- ▶ Habits can still capture most of these ideas. Convenience?

Recursive utility / Long run risk

- ▶ Function

$$U_t = \left((1 - \beta)c_t^{1-\rho} + \beta \left[E_t \left(U_{t+1}^{1-\gamma} \right) \right]^{\frac{1-\rho}{1-\gamma}} \right)^{\frac{1}{1-\rho}}.$$

γ = risk aversion $\rho = 1/\text{eis}$. Power utility for $\rho = \gamma$.

- ▶ Fear = utility index

$$\begin{aligned} M_{t+1} &= \beta \left(\frac{c_{t+1}}{c_t} \right)^{-\rho} \left(\frac{U_{t+1}}{\left[E_t \left(U_{t+1}^{1-\gamma} \right) \right]^{\frac{1}{1-\gamma}}} \right)^{\rho-\gamma} \\ &= \beta \left(\frac{c_{t+1}}{c_t} \right)^{-\rho} (Y_{t+1})^{\rho-\gamma}. \end{aligned}$$

Recursive utility / Long run risk

- ▶ Fear: news of future long-horizon consumption. ($\rho \approx 1$).

$$\Delta E_{t+1}(\ln m_{t+1}) \approx -\gamma \Delta E_{t+1}(\Delta c_{t+1}) + (1-\gamma) \left[\sum_{j=1}^{\infty} \beta^j \Delta E_{t+1}(\Delta c_{t+1+j}) \right]$$

- ▶ Features/thoughts

1. iid Δc , reduces to power utility. Needs predictable Δc .
2. Current conditions Δc_t are essentially irrelevant to fear. Only from coincidence / assumption that current Δc_t is correlated with long run $E_t \Delta c_{t+j}$. (Not strong in data)
3. Is there really a lot of news about long run future Δc ? Is that really the fear in 2008? Or “Dark Matter?” (Chen, Dou, Kogan)
4. Time-varying risk premium, return predictability volatility, etc. must come from exogenously changing $\sigma_t(\Delta c_{t+1})$
5. → Interesting phenomena all from hard-to-see features of exogenous consumption process. Habits: endogenous rise in RA.
6. “Separates IES / RA.” “Solves risk free rate puzzle (high risk aversion, steady low R^f).” (Still needs high RA). But so do habits!
7. “Preference for early resolution of uncertainty.” “Separate time vs. state separability” Feature or bug?

(Note: Bansal Yaron Kiku consumption process)

$$\Delta c_{t+1} = \mu_c + x_t + \sigma_t \eta_{t+1}$$

$$x_{t+1} = \rho x_t + \phi_e \sigma_t e_{t+1}$$

$$\sigma_{t+1}^2 = \bar{\sigma}^2 + v(\sigma_t^2 - \bar{\sigma}^2) + \sigma_w w_{t+1}$$

$$\Delta d_{t+1} = \mu_d + \phi x_t + \pi \sigma_t \eta_{t+1} + \phi \sigma_t u_{d,t+1}$$

Constantinides and Duffie – idiosyncratic risk

- ▶ Bottom line:

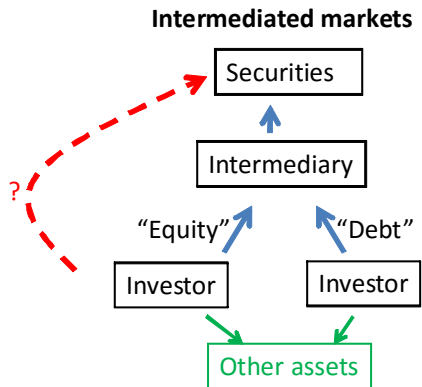
$$M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(e^{\frac{\gamma(\gamma+1)}{2} y_{t+1}^2} \right)$$

y_{t+1} = *cross-sectional variance* of consumption growth.

$$\Delta c_{t+1}^i = \Delta c_{t+1} + \eta_{i,t+1} y_{t+1} - \frac{1}{2} y_{t+1}^2; \sigma^2(\eta_{i,t+1}) = 1$$

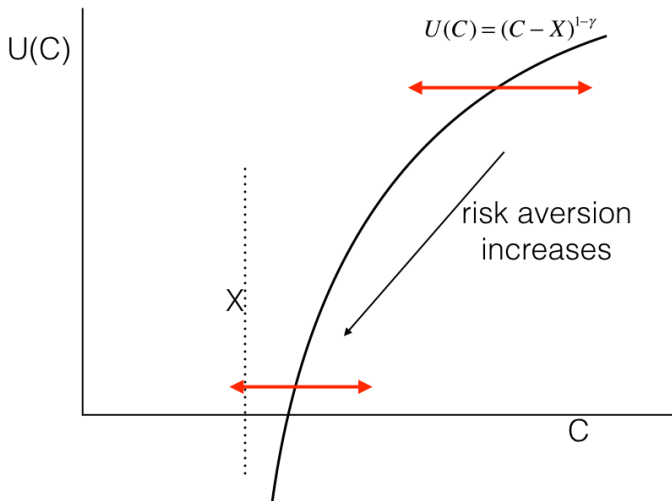
- ▶ Needs $y = \sigma(\text{cross-sectional variance})$ large, varies with business cycles, conditional distribution varies over time. Exogenous, or needs new theory
- ▶ New work in data (Schmidt). Maybe individual rare “disasters” in recessions drives $\sigma(\Delta c)$?

Balance sheets – debt – institutional / intermediated finance



- ▶ As people / intermediaries lose money, closer to default, they get more risk averse

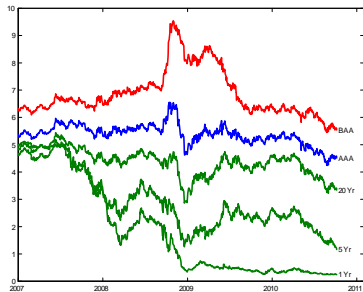
Debt can look just like habit



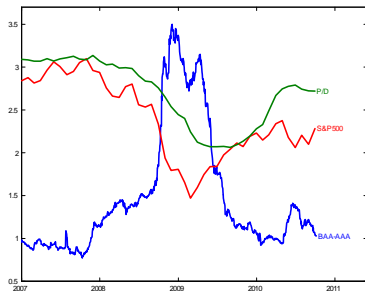
Debt/intermediated objections

- ▶ Why do agents get *more* risk averse as they approach bankruptcy, not *less*?
- ▶ OK for obscure CDS. But why not buy S&P500 directly?
- ▶ Why get in so much debt in the first place? Why use agents?
- ▶ Where are unconstrained, debt-free rich people, Warren Buffet, endowments, sovereign wealth funds etc.? (Answer: selling in a panic just like everyone else.)
- ▶ Why the strong correlation to macroeconomics? (Will the true state variable please stand up?)
- ▶ Why are individual mean returns strongly associated with comovement (factors)?
- ▶ Data (2008): Widespread coordinated rise in all risk premiums, including easy-to-trade, held in your and my 401(k) and Vanguard's website.

A common risk premium



Bond yields



Bonds and stocks

Rare disasters

$$E_t(R_{t+1}) - R_t^f = \text{cov}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\gamma}, R_{t+1} \right]$$

- ▶ A small chance of a very low C_{t+1}/C_t can drive the whole covariance, raise $E_t R_{t+1}$ despite reasonable γ , and despite samples with small $\sigma(\Delta c_{t+1})$.
- ▶ Objections:
 1. Shouldn't we see them more often? (Data controversy)
 2. Beyond equity premium? To get return predictability, p/d volatility, varying volatility, we need time-varying probabilities of rare disasters. External measurement or dark matter?
 3. We seem to need different time-varying probabilities for different assets (Gabaix).
 4. Correlation with business cycles? Probability of rare disasters exogenously correlated with business cycles? Or causality from stocks to recessions?

Probability assessments

$$P_t U'(C) = \beta \sum_s \pi_s U'(C_s) X_s$$

- ▶ π , U' always enter together. There is no way to tell them apart without a priori restriction – $U'(C)$ or $\pi(Y)$
- ▶ Do surveys “what do you expect” reveal $E = \sum \pi$ or $E^* = \sum \pi U'$?
- ▶ Some model restricting π to other data, $\pi(Y)$, or dark matter?
- ▶ Why the business cycle correlation?
- ▶ Min - max; robust control

$$P_t U'(C) = \beta \min_{\{\pi \in \Theta\}} \sum_s \pi_s(Y_s) U'(C_s) X_s$$

But what's θ ? Why time-varying and business cycle related?

Summary:

- ▶ Many ideas give about the same result. An extra, recession-related state variable,

$$M_{t+1} = \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} Y_{t+1}$$

- ▶ No model yet decisively improves on habit in describing time-varying, business-cycle related risk premia; return predictability; “excess” volatility; “bubbles” associated with business cycles, long-run equity premium.
- ▶ No other model does so without relying on exogenous variation in the consumption process, just-so correlations (ΔC_t with long run news) “dark matter” (time varying rare probabilities, business cycle correlated “sentiment,” long run news), rather than endogenous variation in risk premiums
- ▶ Habit, despite neglect, is at least still a convenient formalism for capturing the common ideas.

Risk averse recessions

- ▶ Time to unite with production, general equilibrium! Integrate finance and macro (alternative to frictions)
- ▶ Keynesian: Recessions are driven by static flows:
 $C = a + mpcY; I = \bar{I} - br; \text{ etc.}$
- ▶ New-Keynesian: Recessions are intertemporal substitution

$$c_t = E_t c_{t+1} - \sigma r_t = E_t c_{t+1} - \sigma (i_t - E_t \pi_{t+1})$$

- ▶ Habit vision: Recessions are driven by endogenous time-varying *risk aversion*, not intertemporal substitution.
- ▶ Vision: Small shock. Risk aversion rises. Precautionary savings rise.

$$r = \delta + \gamma \left(\frac{c}{c-x} \right) E \left(\frac{dc}{c} \right) - \frac{1}{2} \gamma (\gamma + 1) \left(\frac{c}{c-x} \right)^2 \sigma^2$$

(Looks like “discount rate shock” of NK models.) Consumption declines. ($E dc/c$ rise.) Risk aversion rises some more. .. Asset prices decline. Investment declines. C+I.. Output declines. Almost multiplier-accelerator.

- ▶ Does it work?

Simple GE model 1: PIH with habit

$$\max \frac{(c_0 - x)^{1-\gamma}}{1-\gamma} + E \left[\frac{(c_1 - x)^{1-\gamma}}{1-\gamma} \right]$$

$$c_1 = (e_0 - c_0) + e_1$$

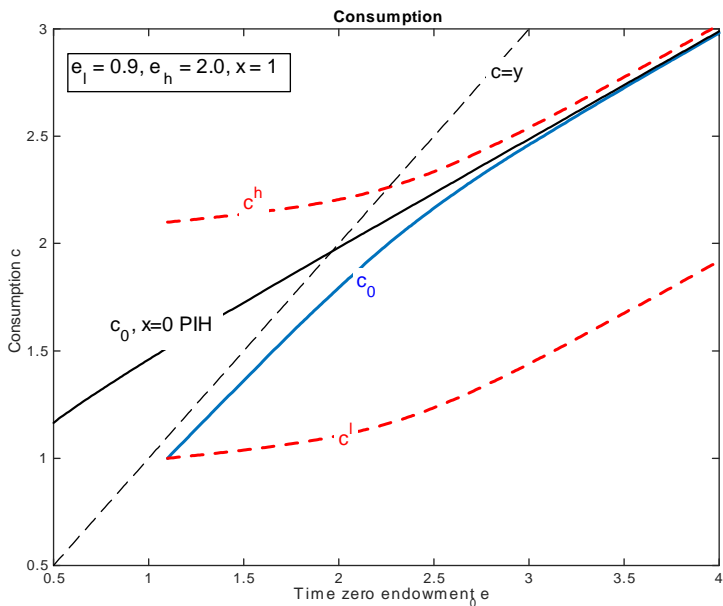
$$e_1 = \{e_h, e_l\} \quad pr(e_l) = \pi_l.$$

$$(c_0 - x)^{-\gamma} = E(c_1 - x)^{-\gamma}$$

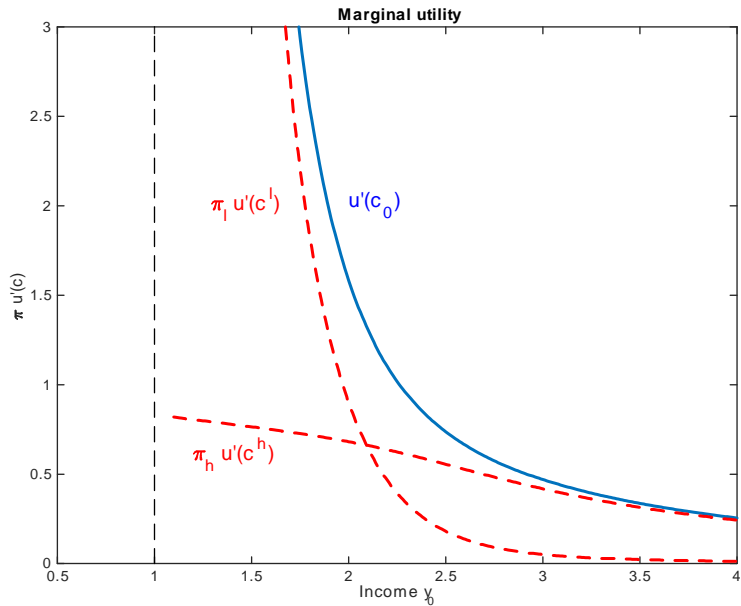
$$(c_0 - x)^{-\gamma} = \pi_l(c_l - x)^{-\gamma} + \pi_h(c_h - x)^{-\gamma}$$

- ▶ $x = 1$, $\gamma = 2$, $e_h = 2$, $e_l = 0.9$ ($< x!$), $\pi = 0.01$ (endpoint)
- ▶ c_0 falls drastically in bad times, to make sure $c_l > x$
- ▶ c_0 acts like buffer stock, leverage, debt models: high *mpc* for low c .
- ▶ $u'(c_0) = \pi_h u'(c_h)$ for high e_0 , but $u'(c_0) = \pi_l u'(c_l)$ for low e_0 .
Like min-max, ambiguity aversion, rare disaster, salience models.
- ▶ Stock prices fall, expected returns rise. Investment to fall?

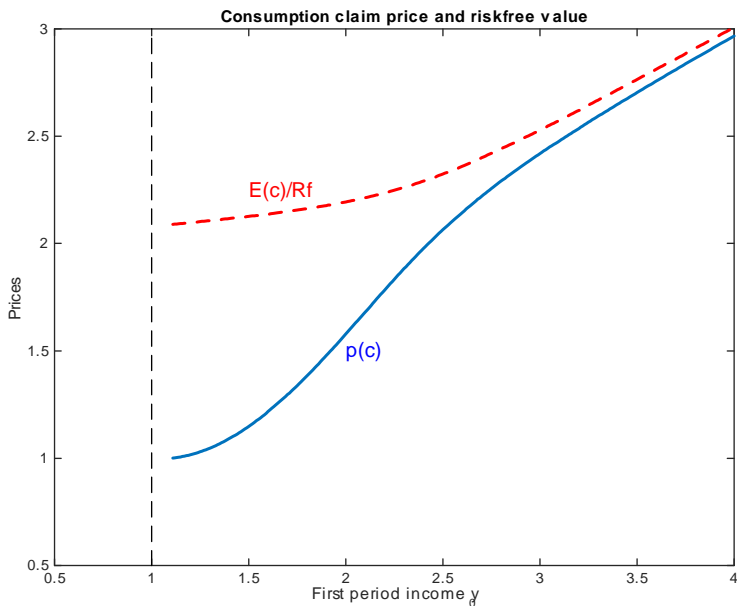
Rising mpc in bad times



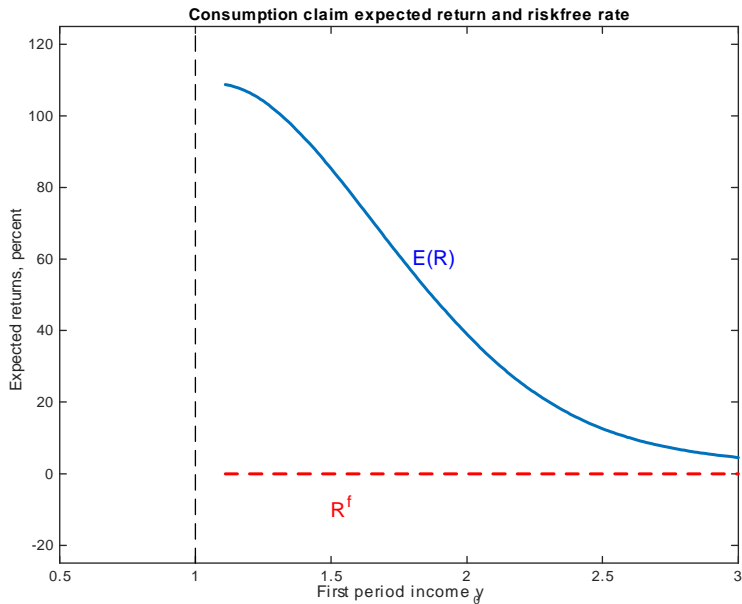
Minimax, rare disaster behavior



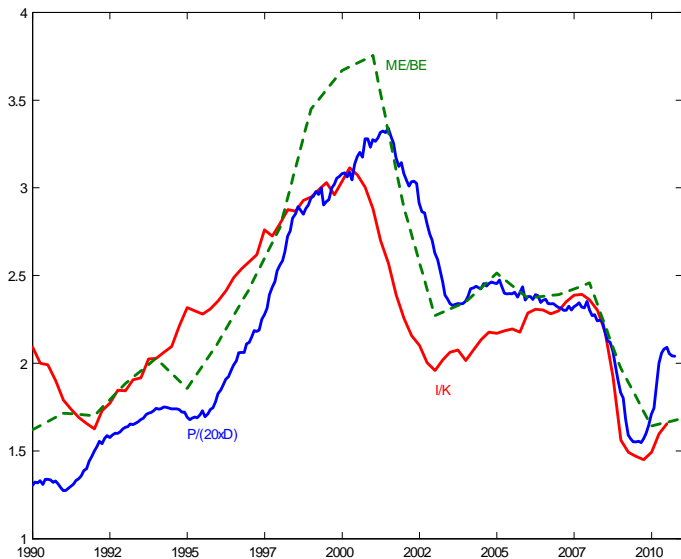
Stock prices fall



Risk Premia Rise



Investment and Q



$$1 + \alpha \frac{i_t}{k_t} = \frac{\text{market}_t}{\text{book}_t} = Q_t$$

A risky investment opportunity

$$\max \frac{(c_0 - x)^{1-\gamma}}{1-\gamma} + E \left[\frac{(c_1 - x)^{1-\gamma}}{1-\gamma} \right]$$

$$c_1 = e_1 + \theta_1 i_0 + B_0$$

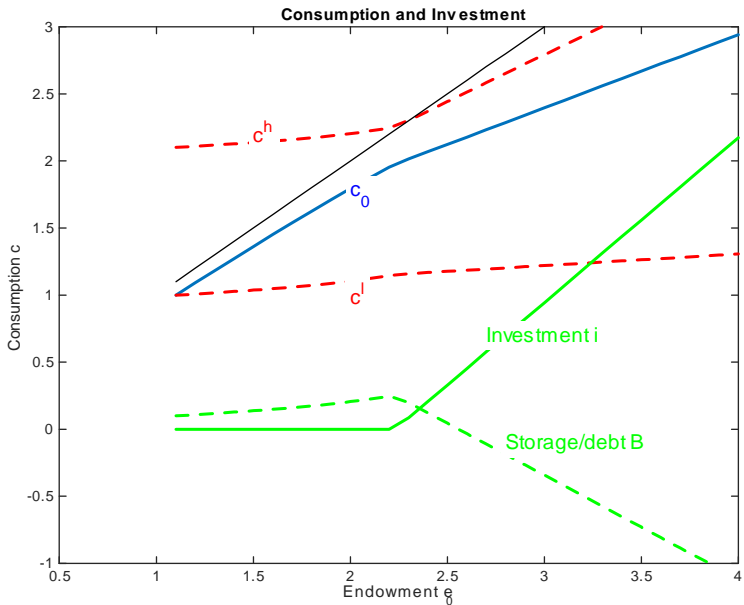
$$c_0 = e_0 - i_0 - B_0 / R^f$$

$$i_0 \geq 0$$

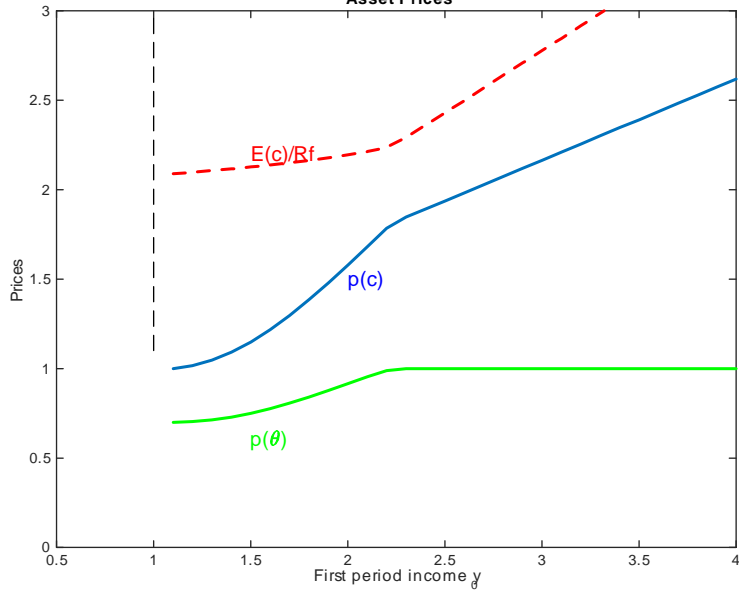
$$(c_0 - x)^{-\gamma} = E(c_1 - x)^{-\gamma}$$

$$(c_0 - x)^{-\gamma} = E[(c_1 - x)^{-\gamma} \theta_1] \text{ if } i_0 > 0.$$

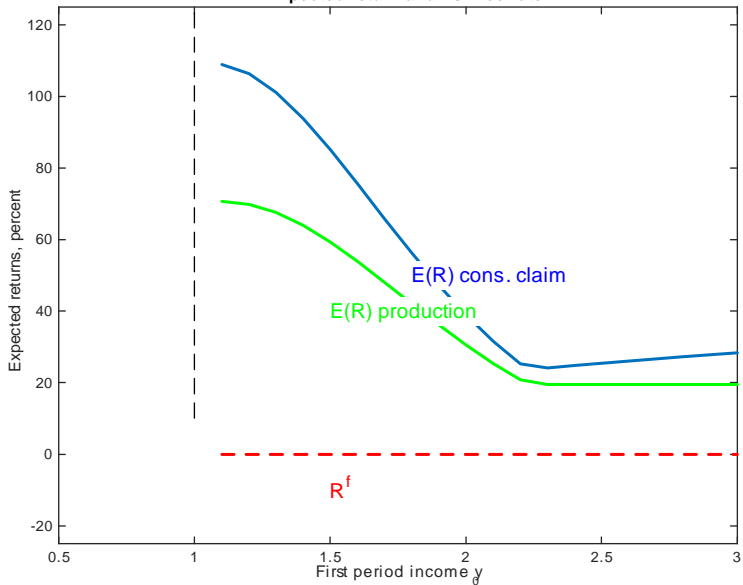
- ▶ $x = 1$, $\gamma = 2$, $e_h = 2$, $e_l = 0.9$ ($< x!$), $\pi = 0.01$,
- ▶ $\rightarrow \theta_l = 0.9$, $\theta_h = 1.2 \leftarrow$
- ▶ Risky investment collapses



Asset Prices



Expected return and riskfree rate



On to recessions

- ▶ The main issue of all macro:
 1. “Demand” falls, but $Y = F(K, L)$. Why does output fall?
 2. If u' rises, hungry, why not work more?

$$\max (c - x)^{1-\gamma} + (h - n)^{1-\gamma} \quad \text{s.t. } c = wn$$
$$(c - x) = w(h - n)$$

3. Desire to save rises. Why does investment fall?
- ▶ Answers:
 1. Traditional: sticky prices, wages.
 2. Shift of investment from risky private opportunity to storage/government debt. (“ R^f ”) Only i counts as y .
 3. h habit?
 4. Private work contributes to risky project which is being scaled back.

$$c_1 = e_1 + \theta_1 \min(i_0, n_0) + B_0$$

$$c_0 = e_0 - i_0 - B_0$$

$$i_0 \geq 0; h > n > 0$$

→ $i_0 = n_0$ collapses

- ▶ Summary: Private economy is a risky project. Everyone wants to put in less money and less labor effort.
- ▶ Real dynamic model...

Summary

- ▶ Empirical: Asset prices are driven by a large, time-varying, business-cycle correlated risk premium.
- ▶ Theory: Habit captures it, endogenously.
- ▶ Lots of other models capture many of the same ideas. (Elegant? Exogenous? Dark Matter?)
- ▶ Habits capture many of the same ideas of those models. (Convenient?)
- ▶ Business cycle correlation; merge asset pricing and finance!
- ▶ Recessions are phenomena of risk aversion. Precautionary saving; scale back risky production / investment projects; all try to hold government debt.
- ▶ See you in 20 years?