Macroeconomics and Asset Markets: some Mutual Implications.

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The Issue

- Economic Risks: unemployment, stock returns, business cycles. How much do they matter?
- Economic Policy: Risk Management.
- Macroeconomic Risks: not diversifiable.
- Price of Risks: Asset Markets.

Asset Markets vs Macro

- Asset pricing literature: take economic choices as given, determine prices from preferences or vice versa.
- Macro literature: take preferences as given, solve for economic choices.
- Each imposes discipline on the other.

Some literature

- Mehra-Prescott. Cochrane's book (2001), Campbell's survey (2004).
- Habit formation: Constantinides et al., Abel, Campbell-Cochrane. Risk av. vs intertemp. subst.: Epstein-Zin, Weil, Tallarini. Robust control: Hansen-Sargent-Tallarini. Nonstandard preferences: Kahnemann-Tversky, Backus-Routledge-Zin, many more .
- $E[u'(c_i)] \neq u'(E[c_i])$): Constantinides, Storesletten et al.. Taxes: McGrattan-Prescott.
- Joint explanation: Jermann, Boldrin - Christiano - Fisher, Lettau-Uhlig, **Tallarini**, **Guvenen**.

Asset Market Facts.

- Campbell (2004)
- **Equity premium: 7.2% annually. Volatility: 15.5%. Sharpe Ratio: 0.46.**
- Excess returns are forecastable, in particular at longer horizons.
- Lettau-Ludvigson. cay_t: consumption, assets and income are cointegrated. Deviations predict corrections in asset prices, not changes in consumption.
- **The safe rate is not very volatile: 1.7% annually.**

Macroeconomic Facts.

- Cooley and Prescott (1999)
- **Labor, labor productivity, consumption are all procyclical.**
- **Consumption fluctuates less than output, hours nearly as much, and investment much more.**

The Question

- What is needed to generate both the risk premium on asset markets as well as the underlying economic choices for consumption, leisure etc?
- Or: given that asset markets imply high risk aversion at the observed economic choices, what is needed in general equilibrium to generate these economic choices under such high risk aversion?
- Or: how can we keep risk bottled up in a macro model in such a way that the risk premium remains high?

Results

- High risk aversion is not enough.
- Fix 1: non-separability between consumption and leisure. Does not work.
- Fix 2: frictions on labor markets, exogenous wages. This works. Plausible?
- Fix 3: heterogeneous agents. Does not work.
- Fix 4: Epstein-Zin preferences. This works. Another paper.
- “Generic” real business cycle model.
- Nonseparability: consumption vs leisure.

A simple example

- Imagine three periods.
  1. given endowment, agent chooses capital k_1, portfolio of zero net supply assets, and thus consumption c_1.
  2. shocks to labor productivity γ_2. Returns R_2 on assets. Agent chooses labor n_2, investment x_2, consumption c_2.
  3. Agent receives returns from capital investment, works, consumes.

A simple example continued

- Asset pricing: $1 = \beta E_t \left[\frac{u'(c_2)}{u'(c_1)} R_2 \right]$
- **Finance:** $c_2 = \gamma_2 + \text{const.}$
  High $u''(c_2)c_2/u'(c_2)$ and high correlation of c_2 and R_2 induce high risk premium.
- **Macro:** $c_2 = \gamma_2 n_2 + R_k k_1 - x_2$.
  High risk aversion means: agents wish to avoid fluctuations in c_2, i.e. avoid risk.
- Escape hatches for risk:
  1. Investment.
  2. Labor.

A simple example continued

- Closing the escape hatches for risk:
  1. Investment: per adjustment costs to capital. Jermann, others. Extreme: fix capital.
  2. - Labor: Literature fixes labor. Here: labor is **countercyclical.**. Data: labor **pro-cyclical**, important feature of business cycles.
     - Solution: wage rigidities. Extreme: fix wages, **make labor** fluctuations **demand driven**. Now: high $\gamma \rightarrow$ high n_2.
- Wage rigidities: Keynes, Hall-Shimer, Blanchard-Gali, others.
- Utility: nonseparability between consumption and leisure?

Overview

1. Introduction •
2. **Asset pricing** •
3. Macroeconomic consequences •
4. A two agent model. •
5. Conclusions. •

Overview: asset pricing.

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Asset Pricing: theory

- $$1 = E_t[\beta \frac{\Lambda_{t+1}}{\Lambda_t} R_{t+1}] \qquad (1)$$

- Notation. $\tilde{\lambda}_{t+1} = \log \Lambda_{t+1}$, etc. No tilde: log-deviation.

- $$0 = \log \beta + \log \left(E_t \left[\exp \left(\Delta \tilde{\lambda}_{t+1} + \tilde{r}_{t+1} \right) \right] \right) \qquad (2)$$

- Assume joint log-normality

Asset Pricing: theory 2

- Risk-free rate:

$$r_t^f = -\log\beta - E_t[\Delta\tilde{\lambda}_{t+1}] - \frac{1}{2}\sigma_{\lambda,t}^2 \qquad (3)$$

- Define the **Sharpe Ratio**

$$\mathcal{SR}_t = \frac{\log E_t[R_{t+1}] - r_t^f}{\sigma_{r,t}}$$

- Result:

$$\mathbf{\mathcal{SR}_t = -\rho_{\lambda,r,t}\sigma_{\lambda,t}} \qquad (4)$$

$$\mathcal{SR}_t^{\max} = \sigma_{\lambda,t} \qquad (5)$$

Utility function

$$U = E\left[\sum_{t=0}^{\infty} \beta^t U(C_t, L_t)\right], \quad \text{stationarity}$$

$$\begin{aligned}
\eta_{cc} &= -\frac{U_{CC}(\bar{C},\bar{L})\bar{C}}{U_C(\bar{C},\bar{L})} \\
\eta_{cl,c} &= \frac{U_{CL}(\bar{C},\bar{L})\bar{C}}{U_L(\bar{C},\bar{L})} \\
\eta_{cl,l} &= \frac{U_{CL}(\bar{C},\bar{L})\bar{L}}{U_C(\bar{C},\bar{L})} \\
\eta_{ll} &= -\frac{U_{LL}(\bar{C},\bar{L})\bar{L}}{U_L(\bar{C},\bar{L})}
\end{aligned}$$

Utility function.

- From macro:

$$\kappa = \frac{\eta_{cl,c}}{\eta_{cl,l}} = \frac{U_C(\bar{C},\bar{L})\bar{C}}{U_L(\bar{C},\bar{L})\bar{L}}$$

  is the ratio of the expenditure shares for consumption and leisure. We shall see: $\kappa \approx 0.58$.

- Convexity:

$$\eta_{ll} \geq \frac{\eta_{cl,c}\eta_{cl,l}}{\eta_{cc}} = \kappa \left(\frac{\eta_{cl,l}^2}{\eta_{cc}} \right)$$

Asset pricing: theory 3

- $$\lambda_t = -\eta_{cc} c_t + \eta_{cl,l} l_t$$

- For risk free rate:

$$E_t[\Delta \tilde{\lambda}_{t+1}] = -\eta_{cc} E_t[\Delta \tilde{c}_{t+1}] + \eta_{cl,l} E_t[\Delta \tilde{l}_{t+1}]$$

- **Sharpe ratio with nonseparable utility:**

$$\mathbf{SR_t} = \eta_{\mathbf{cc}} \rho_{\mathbf{c,r,t}} \sigma_{\mathbf{c,t}} - \eta_{\mathbf{cl,l}} \rho_{\mathbf{l,r,t}} \sigma_{\mathbf{l,t}} \qquad (6)$$

- The Sharpe ratio also depends on the cross-derivative term $\eta_{cl,l}$. Therefore, asset pricing facts can be explained with low cons. risk aversion, if $\eta_{cl,l}$ etc. are chosen appropriately.

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Asset pricing: data

- Holding period: k quarters. Volatilities: of $\Delta_k c_t$ etc.. Ignores predictable part except unconditional mean.
- Calculate correlations at various horizons.
- Data: log excess return of S&P 500 (with dividends reinvested) versus 1-year T-bill.

Asset pricing: data 2

k (Quart.)	std.dev. of r_{t+1}	Sharpe ratio	Ann. Sharpe ratio, $SR\sqrt{4/j}$
1	6.87	0.15	0.30
2	10.37	0.21	0.29
3	13.18	0.24	0.28
4	15.40	0.27	0.27
8	22.21	0.36	0.26
12	26.75	0.47	0.27
16	29.47	0.63	0.31
20	31.41	0.82	0.37

Asset pricing: data 3

k (Quart.)	σ_l (leis.)	σ_c (cons.)	$\rho(c, l)$	$\rho(\mathbf{l}, \mathbf{r})$	$\rho(c, r)$
1	0.45	0.67	-0.33	**-0.07**	0.27
2	0.80	1.04	-0.42	**-0.08**	0.34
3	1.11	1.33	-0.51	**-0.15**	0.37
4	1.36	1.64	-0.55	**-0.21**	0.39
8	2.10	2.42	-0.62	**-0.39**	0.42
12	2.46	2.73	-0.62	**-0.50**	0.34
16	2.49	3.01	-0.57	**-0.58**	0.39
20	2.39	3.11	-0.48	**-0.59**	0.41

Asset pricing: data 4

- Time variation in volatility: GARCH,

$$\sigma_{l,t}^2 = (1-\phi)\sigma_{l,t-1}^2 + \phi(l_t - l_{t-1} - E[l_t - l_{t-1}])^2$$

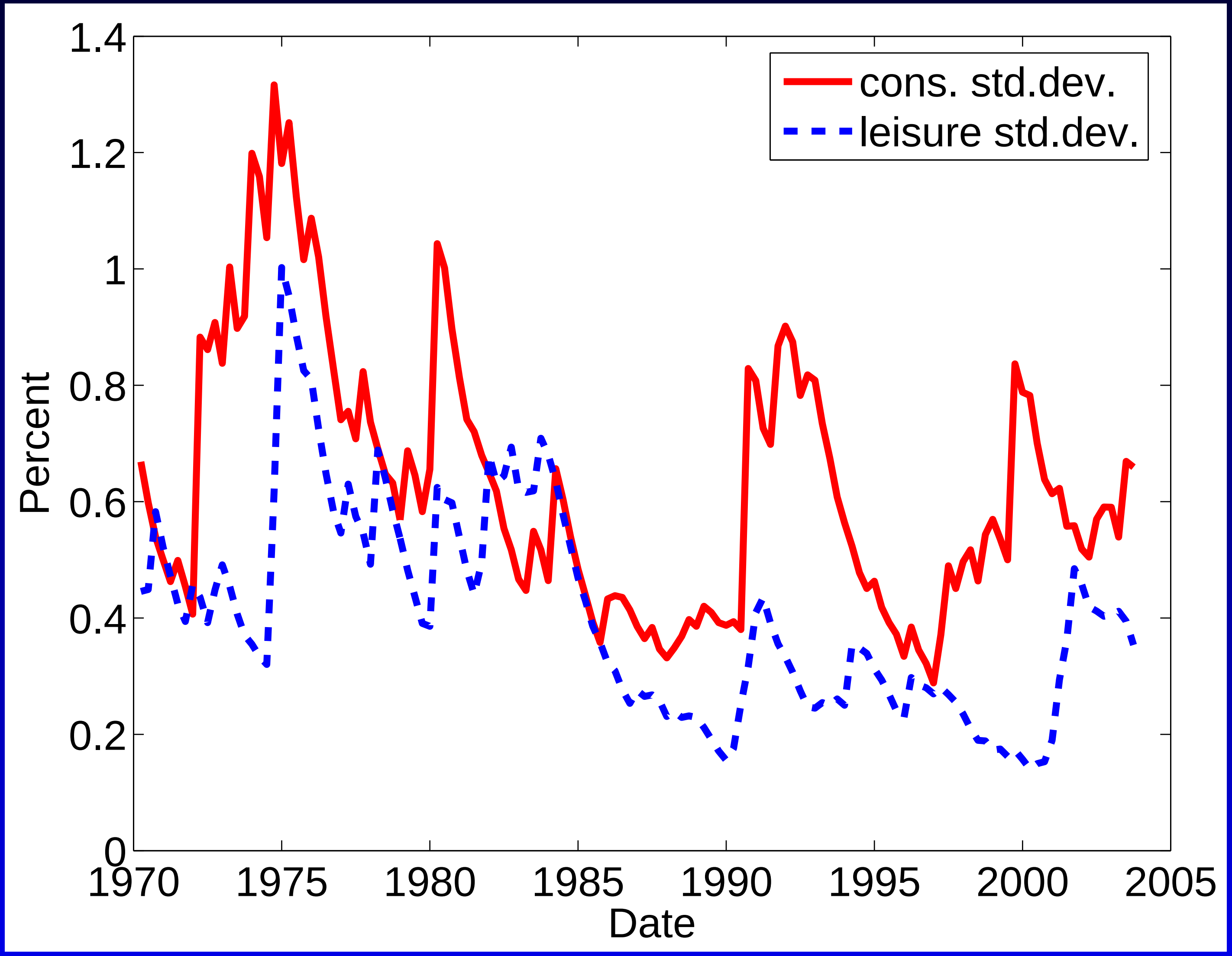
etc.

- Assuming constant correlations,

$$\Delta SR_{t+1} = \eta_{cc}\rho_{c,r}\Delta\sigma_{c,t+1} - \eta_{cl,l}\rho_{l,r}\Delta\sigma_{l,t+1} \qquad (7)$$

- Interpretation: surprise increases in macroeconomic volatility (i.e rising business cycle uncertainty) should lead to surprise falls in stock prices. Data: they do for leisure.

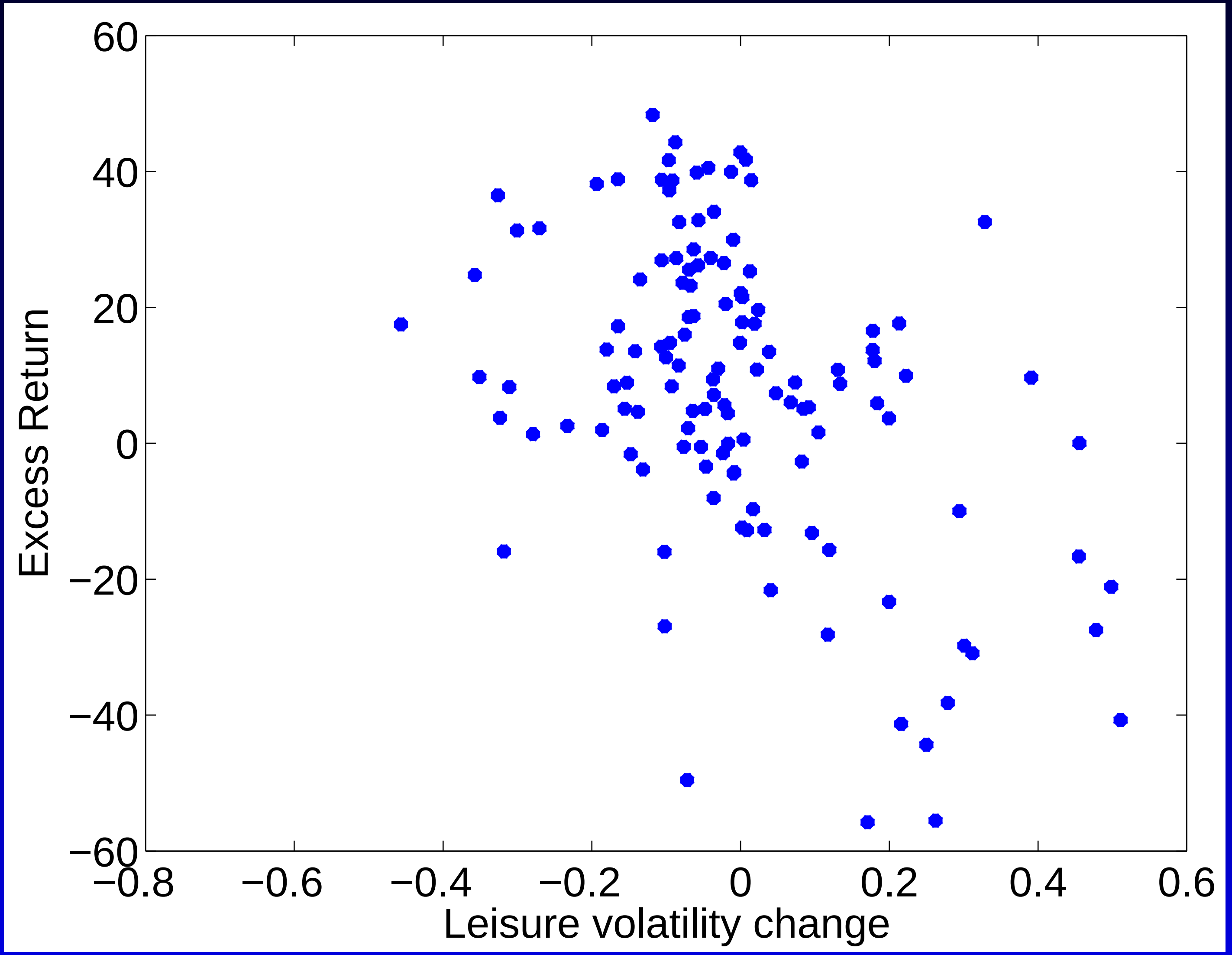
Macroeconomic Volatility

- 

Asset pricing: data 5

k	σ of $\sigma_{l,t}$	σ of $\sigma_{c,t}$	$\rho(\sigma_c, \sigma_l)$	$\rho(\sigma_\mathbf{l}, \mathbf{r})$	$\rho(\sigma_c, r)$
1	0	0.01	0.18	**0.06**	0.00
2	0.01	0.02	0.22	**-0.01**	-0.00
3	0.02	0.02	0.24	**-0.13**	-0.01
4	0.02	0.03	0.21	**-0.23**	-0.00
8	0.03	0.07	0.17	**-0.46**	0.02
12	0.04	0.10	0.24	**-0.53**	-0.07
16	0.05	0.11	0.38	**-0.52**	-0.11
20	0.05	0.10	0.43	**-0.52**	-0.09

Leisure vol. and returns, $k = 8$.



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Preference implications

- Benchmark case: $\eta_{cl,l} = 0$. Campbell (2004).

$$\eta_{cc} = \frac{SR}{\rho_{c,r}\sigma_c} = \frac{0.27}{1.64\% * 0.39} = 42 \text{ for } k = 4 \tag{8}$$

- With $\eta_{cl,l} \neq 0$:

$$\eta_{cl,l} = \frac{SR - \eta_{cc}\rho_{c,r}\sigma_c}{-\rho_{l,r}\sigma_l} \tag{9}$$

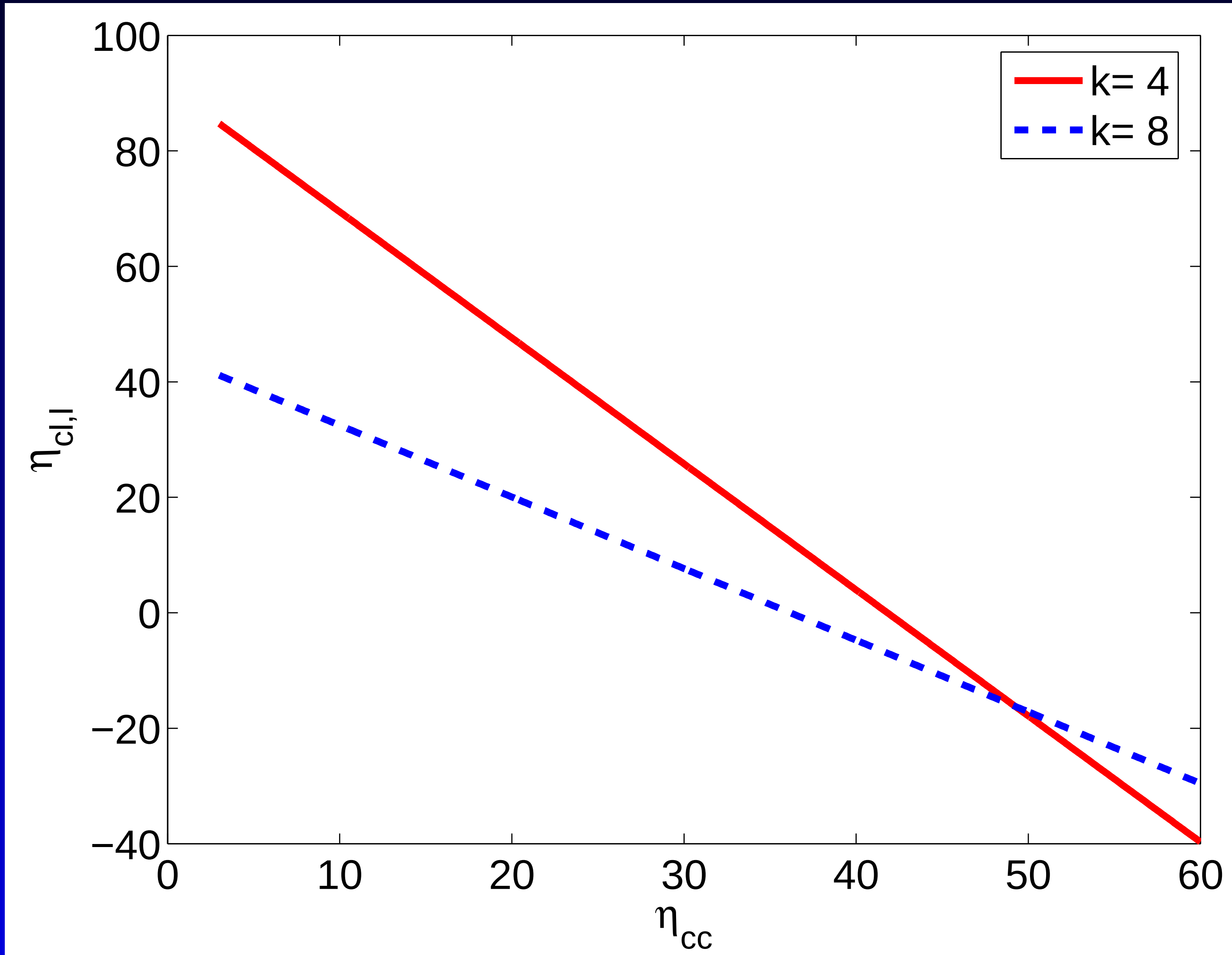
- Desirable: η_{ll} as low as possible. Thus,

$$\eta_{ll} = \frac{\kappa \eta_{cl,l}^2}{\eta_{cc}}$$

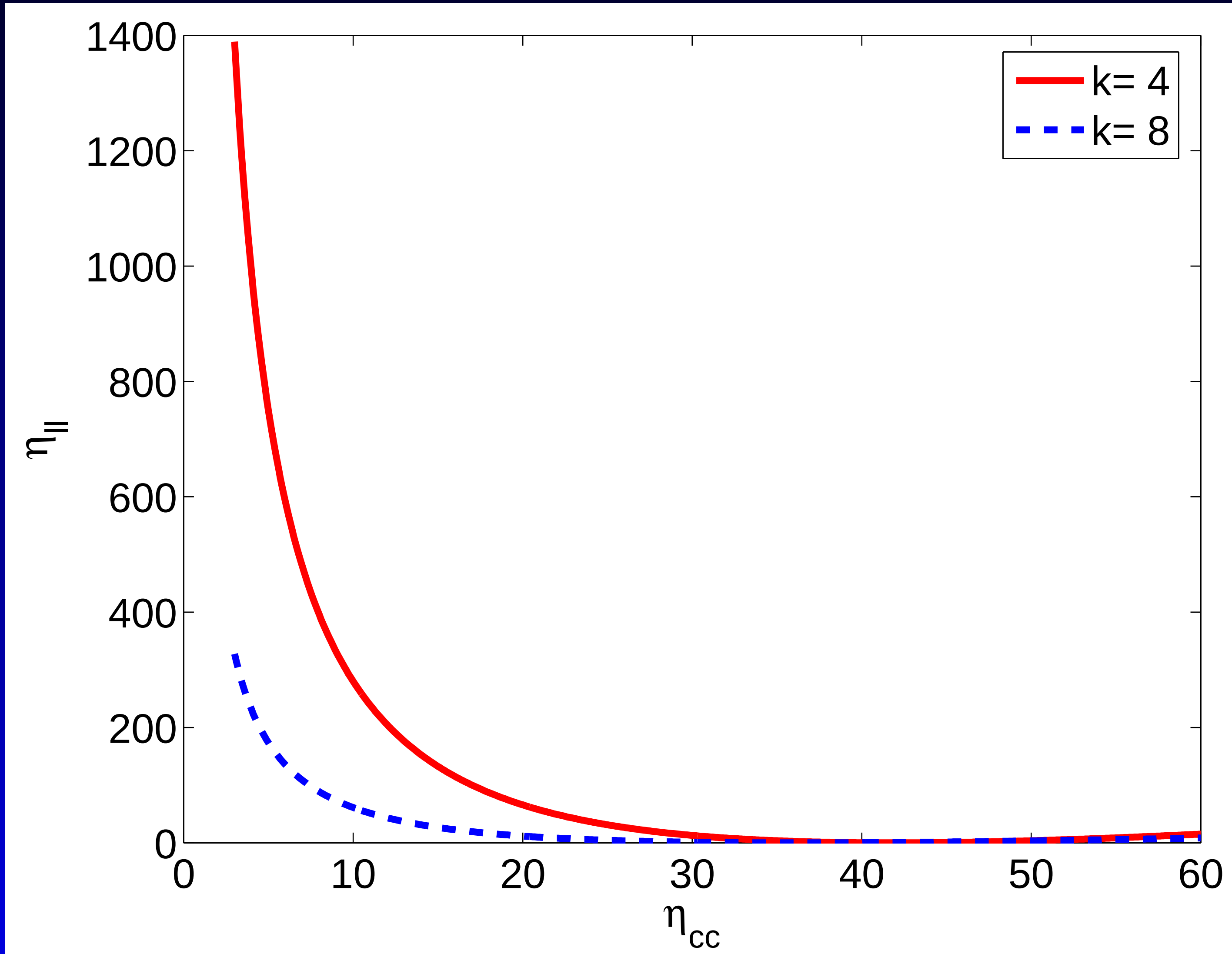
Preference implications 2

η_{cc}	η_{cl_l}		η_{ll}	
	k=4	**k=8**	k=4	**k=8**
3.0	84.7	41.1	1389.2	327.5
5.0	80.4	**38.7**	749.8	**173.5**
10.0	69.5	**32.5**	280.0	**61.2**
15.0	58.5	**26.3**	132.6	**26.7**
20.0	47.6	**20.1**	65.8	**11.7**
30.0	25.8	7.7	12.9	1.1
40.0	4.0	-4.7	0.2	0.3
50.0	**-17.9**	-17.1	**3.7**	3.4

The cross-derivative term $\eta_{cl,l}$.



Leisure risk aversion η_{ll}.



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A generic model

$$\max E\left[\sum_{t=0}^{\infty}\beta^t U(C_t, L_t)\right]$$

$$\begin{aligned} C_t + X_t &= Y_t = Z_t F(K_{t-1}, N_t) \\ K_t &= (1-\delta)K_{t-1} + G\left(\frac{X_t}{K_{t-1}}\right)K_{t-1} \\ 1 &= N_t + L_t \end{aligned}$$

C_t:consumption. L_t: leisure. X_t: investment. K_t: capital. Y_t: output. N_t: labor. Z_t: TFP. U: utility function. F: production function for output, const. ret. to scale. G: adjustment cost function for capital.

Utility function

$$\eta_{cc} = -\frac{U_{CC}(\bar{C},\bar{L})\bar{C}}{U_C(\bar{C},\bar{L})}$$

$$\eta_{cl,c} = \frac{U_{CL}(\bar{C},\bar{L})\bar{C}}{U_L(\bar{C},\bar{L})}$$

$$\eta_{cl,l} = \frac{U_{CL}(\bar{C},\bar{L})\bar{L}}{U_C(\bar{C},\bar{L})}$$

$$\eta_{ll} = -\frac{U_{LL}(\bar{C},\bar{L})\bar{L}}{U_L(\bar{C},\bar{L})} \geq \left(\frac{\eta_{cl,c}}{\eta_{cl,l}}\right)\left(\frac{\eta_{cl,l}^2}{\eta_{cc}}\right)$$

Production function

$$\theta = \frac{F_K(\bar{K}, \bar{N})\bar{K}}{F(\bar{K}, \bar{N})}$$

$$\phi_{kk} = -\frac{F_{KK}(\bar{K}, \bar{N})\bar{K}}{F_K(\bar{K}, \bar{N})}$$

$$\phi_{nn} = -\frac{F_{NN}(\bar{K}, \bar{N})\bar{N}}{F_N(\bar{K}, \bar{N})}$$

Production function 2

Thus,

$$\phi_{kk} = \frac{F_{KN}(\bar{K},\bar{N})\bar{N}}{F_K(\bar{K},\bar{N})}$$

$$\phi_{nn} = \frac{F_{KN}(\bar{K},\bar{N})\bar{K}}{F_N(\bar{K},\bar{N})}$$

Cobb-Douglas: $\phi_{kk} = 1 - \theta$ and $\phi_{nn} = \theta$

Adjustment cost function

- $G(\delta) = \delta$
- $G'(\delta) = 1$
- $$\xi = -\frac{1}{G''(\delta)\delta} > 0$$
- $\xi = \infty$: no adj. cost. $\xi = 0.23$.

Loglinearization

feasib.	$y_t = \frac{\bar{X}}{\bar{Y}} x_t + \left(1 - \frac{\bar{X}}{\bar{Y}}\right) c_t$
goods prod.:	$y_t = \theta k_{t-1} + (1-\theta) n_t$
cap. prod.:	$k_t = (1-\delta) k_{t-1} + \delta x_t$
wages:	$w_t = z_t + \phi_{nn}(k_{t-1} - n_t)$
dividends:	$d_t = z_t - \phi_{kk}(k_{t-1} - n_t)$
time:	$l_t = -\frac{1-\bar{L}}{\bar{L}} n_t$
shadow v. of c:	$\lambda_t = -\eta_{cc} c_t + \eta_{cl,l} l_t$
shadow v. of l::	$\lambda_t + w_t = \eta_{cl,c} c_t - \eta_{ll} l_t$
adj. cost:	$\psi_t = \frac{1}{\xi}(x_t - k_{t-1})$
ret. on cap.:	$r_t = \frac{\bar{R}-1+\delta}{\bar{R}} d_t - \psi_{t-1} + \frac{1}{\bar{R}} \psi_t$
asset pric.:	$0 = E_t\left[\lambda_{t+1} - \lambda_t + r_{t+1}\right]$

Free Parameters

parameter	econ.	calibr.
θ	cap. share	0.36
δ	deprec.	0.025
$\bar{R}$	gross cap. ret.	1.01
ϕ_{nn}	elast. of w.	θ (Cobb-Douglas)
ϕ_{kk}	elast. of d.	$1 - \theta$ (Cobb-Douglas)
$\xi \geq 0$	adj. cost	0.23 or ∞
$\bar{L}$	leis. share	2/3
η_{cc}	cons. risk. av.	$[1, \infty)$
$\eta_{cl,l}$	cross der.	$(-\infty, \infty)$

Parameter Restrictions

parameter	Restrictions: theory	econ.	calibr.
$\frac{\bar{X}}{\bar{Y}}$	$= \frac{\delta\theta}{\bar{R}-1+\delta}$	inv. share	25.7%
$\kappa = \frac{\eta_{cl,c}}{\eta_{cl,l}}$	$= \frac{(1-\bar{L})}{\bar{L}} \frac{\left(1-\frac{\bar{X}}{\bar{Y}}\right)}{(1-\theta)}$	rel. exp. sh.	0.58
η_{ll}	$\geq \frac{\kappa\eta_{cl,l}^2}{\eta_{cc}}$	leis. risk. av.	$[0, \infty)$

Macroeconomic Implications

- Exogenous process for technology:

$$z_t = 0.95 z_{t-1} + \epsilon_t$$

- $\sigma_\epsilon = 0.712$.

The benchmark model

- A representative agent. Fix $\eta_{cc} = 40$. Vary the adjustment costs to capital ξ.

One agent, no frictions, $\eta_{cc} = 40$.

ξ^{-1}	σ_y	σ_n	$\rho_{n,y}$	σ_c	$\rho_{c,y}$	σ_x	$\rho_{x,y}$	SR	σ_{rf}
0	0.88	0.38	-0.13	0.03	0.92	3.46	1.00	0.01	0.10
1	0.21	1.12	-1.00	0.03	1.00	0.74	1.00	0.02	0.15
2	0.13	1.24	-1.00	0.03	1.00	0.43	1.00	0.02	0.16
3	0.10	1.28	-1.00	0.03	1.00	0.31	1.00	0.02	0.16
4	0.09	1.31	-1.00	0.04	1.00	0.24	1.00	0.02	0.17
5	0.08	1.33	-1.00	0.04	1.00	0.20	1.00	0.02	0.18
U.S.:	2.13	1.79	0.86	1.30	0.82	8.07	0.86	0.26	1.7

The benchmark model

- Verdict: A failure. High risk aversion alone does not do the trick. Agents find ways to avoid risk, e.g. per countercyclical labor. The Sharpe ratio is too low.

Fix 1: nonseparable preferences

- A representative agent. Use $U(C, L)$.
- Vary η_{cc}. Calculate the implied $\eta_{cl,c}, \eta_{cl,l}, \eta_{ll}$, using the asset market equations, the leisure-to-consumption ratio and the convexity condition.
- Vary ξ.

One agent, no frictions, $U(C, L)$

η_{cc}	σ_y	σ_n	$\rho_{n,y}$	σ_c	$\rho_{c,y}$	σ_x	$\rho_{x,y}$	SR	σ_{rf}
				$\xi = \infty, \xi^{-1} = 0$:					
1	1.30	0.32	0.28	7.01	-0.27	22.99	0.47	0.00	0.01
5	1.29	0.63	0.58	2.44	-0.57	11.12	0.84	0.00	0.04
20	1.08	0.46	0.48	0.23	-0.37	4.60	0.99	0.01	0.08
40	0.85	0.39	-0.24	0.02	0.85	3.34	1.00	0.02	0.11
U.S.:	2.13	1.79	0.86	1.30	0.82	8.07	0.86	0.26	1.7

One agent, no frictions, $U(C, L)$

η_{cc}	σ_y	σ_n	$\rho_{n,y}$	σ_c	$\rho_{c,y}$	σ_x	$\rho_{x,y}$	$\mathcal{SR}$	σ_{rf}
$\xi = 0.5, \xi^{-1} = 4$:									
1	0.89	0.05	-1.00	1.11	1.00	0.24	1.00	0.00	0.00
5	0.77	0.24	-1.00	0.95	1.00	0.26	1.00	0.00	0.02
20	0.41	0.80	-1.00	0.44	1.00	0.33	1.00	0.01	0.08
40	0.08	1.31	-1.00	0.04	-1.00	0.46	1.00	0.02	0.17
U.S.:	2.13	1.79	0.86	1.30	0.82	8.07	0.86	0.26	1.7

One agent, no frictions, $U(C,L)$

η_{cc}	σ_y	σ_n	$\rho_{n,y}$	σ_c	$\rho_{c,y}$	σ_x	$\rho_{x,y}$	SR	σ_{rf}
$\xi = 0.25, \xi^{-1} = 2$:									
1	0.89	0.05	-1.00	1.15	1.00	0.13	1.00	0.00	0.00
5	0.77	0.24	-1.00	0.98	1.00	0.14	1.00	0.00	0.02
20	0.39	0.84	-1.00	0.46	1.00	0.18	1.00	0.01	0.09
40	0.03	1.40	-0.99	0.04	-0.99	0.26	1.00	0.02	0.18
U.S.:	2.13	1.79	0.86	1.30	0.82	8.07	0.86	0.26	1.7

Fix 1: nonseparable preferences

- Verdict: A failure. Risk aversion is not really gone. Agents shift risk to where it hurts the least, but still avoid risk. The Sharpe ratio is too low.

Fix 2: sluggish wages.

- Replace FOC wrt leisure with

$$w_t = \mu w_{t-1} + (1-\mu) w_t^f \tag{10}$$

and the definition of the frictionless wage,

$$w_t^f = -\lambda_t + \eta_{cl,c} c_t - \eta_{ll} l_t \tag{11}$$

- Hall, Shimer, others. This specification: Blanchard-Gali.
- Includes frictionless case at $\mu = 0$.

frictions, $\eta_{cc} = 40, \xi = 0.5$

μ	σ_y	σ_n	$\rho_{n,y}$	σ_c	$\rho_{c,y}$	σ_x	σ_w	$\rho_{w,y}$	$\mathcal{SR}$	σ_{rf}
0.00	0.08	1.31	-1.00	0.04	-1.00	0.46	1.40	1.00	0.02	0.17
0.50	0.20	1.24	-0.63	0.04	0.09	0.78	1.37	0.71	0.04	1.01
0.80	0.52	1.16	-0.08	0.11	0.88	1.81	1.31	0.47	0.09	2.57
0.90	0.90	1.23	0.36	0.20	0.96	3.03	1.24	0.37	0.13	3.54
0.95	1.37	1.48	0.69	0.31	0.98	4.56	1.12	0.31	0.18	3.97
0.96	1.53	1.59	0.77	0.35	0.99	5.09	1.07	0.29	0.19	4.04
0.97	1.74	1.75	0.84	0.41	0.99	5.75	0.98	0.27	0.21	3.96
0.98	2.00	1.96	0.91	0.47	0.99	6.57	0.84	0.25	0.23	3.61
0.99	2.28	2.23	0.97	0.57	1.00	7.43	0.57	0.22	0.27	3.20
U.S.:	2.13	1.79	0.86	1.30	0.82	8.07	0.89	0.14	0.26	1.7

Fix 2: sluggish wages.

- Verdict: This works! Surprisingly reasonable numbers for $\mu = 0.97$.
- Are wages now too sluggish?
- Agents wish to avoid risk, but cannot, due to labor market rigidities. Is this reasonable? Welfare costs?

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Fix 3: A two-agent economy.

- Campbell-Cochrane (1999): highly nonlinear, external habit explain asset pricing observations.
- Ljungqvist-Uhlig (2003): endogenizing consumption choices with CC preferences has unusual consequences. E.g., an agent is significantly better off by periodically destroying parts of a constant stream of endowment. Reason: utility has local and global nonconcavities.
- Guvenen (2003): habit stock = consumption of "poor". Asset pricing in terms of consumption of participating agents. Proposes two-agent economy.

A two-agent economy.

- “Capitalist”: owns capital, does not work, trades in the riskless bond. Risk aversion = 2.
- “Worker”: owns time, does not trade in capital. Trades in the riskless bond. Risk aversion = 10.
- Guvenen (2003): emphasizes nonlinearities, etc.. Here: extend benchmark model and study the loglinearized dynamics. Easier to understand.
- Guvnenen (2003) fixes labor, $\eta_{ll} = \infty$. Guvenen-Kuruscu (2006): Cobb-Douglas preferences. Large volatility of tech. shock.
- We consider $\eta_{ll} = \infty$, $\eta_{ll} = 0$, Cobb-Douglas utility versus sluggish wages.

The capitalist.

$$\max E\left[\sum_{t=0}^{\infty}\beta^t U^{(C)}(C_t^{(C)})\right]$$

$$\begin{aligned} C_t^{(C)} + B_t + X_t &= D_t K_{t-1} + R_{t-1}^f B_{t-1} \\ K_t &= (1-\delta)K_{t-1} + G\left(\frac{X_t}{K_{t-1}}\right)K_{t-1} \end{aligned}$$

The worker.

$$\max E\left[\sum_{t=0}^{\infty}\beta^t U^{(W)}(C_t^{(W)}, L_t)\right]$$

$$\begin{aligned} C_t^{(W)} - B_t &= W_t N_t - R_{t-1}^f B_{t-1} \\ 1 &= N_t + L_t \end{aligned}$$

Four Possibilities:

- $\eta_{ll}^{(W)} = \infty$: Guvenen 2003.
- $U(C, L)$ Cobb-Douglas: Guvenen-Kuruscu 2006.
- $\eta_{ll}^{(W)} = 0$.
- Sluggish wages.

Loglinearization: the changes.

$$
\begin{aligned}
y_t &= \frac{\bar{X}}{\bar{Y}} x_t + \frac{\bar{C}^{(C)}}{\bar{Y}} c_t^{(C)} + \frac{\bar{C}^{(W)}}{\bar{Y}} c_t^{(W)} \\
\\
\lambda_t^{(W)} &= -\eta_{cc}^{(W)} c_t^{(W)} + \eta_{cl,l}^{(W)} l_t \\
\lambda_t^{(W)} + w_t &= \eta_{cl,c}^{(W)} c_t - \eta_{ll}^{(W)} l_t \\
\lambda_t^{(C)} &= -\eta_{cc}^{(C)} c_t^{(C)} \\
\frac{\bar{C}^{(W)}}{\bar{Y}} c_t^{(W)} - b_t &= (1-\theta)(w_t + n_t) - \bar{R}\frac{\bar{B}}{\bar{Y}} r_{t-1}^f - \bar{R} b_{t-1} \\
0 &= E_t\left[\lambda_{t+1}^{(C)} - \lambda_t^{(C)} + r_{t+1}\right] \\
0 &= E_t\left[\lambda_{t+1}^{(C)} - \lambda_t^{(C)} + r_t^f\right] \\
0 &= E_t\left[\lambda_{t+1}^{(W)} - \lambda_t^{(W)} + r_t^f\right]
\end{aligned}
$$

Free parameters

param.	econ.	calibr.
θ	capital share	0.4
δ	deprec. rate	0.02
$\bar{R}$	gross cap. return	1.01
ϕ_{nn}	elast. of wages	θ
ϕ_{kk}	elast. of div.	$1 - \theta$
$\xi \geq 0$	adj. cost	0.23
$\bar{L}$	leisure share	2/3
$\eta_{cc}^{(C)}$	cons. risk. avers. cap.	2
$\eta_{cc}^{(W)}$	cons. risk. avers. worker	10 or CD
$\eta_{cl,l}^{(W)}$	cross derivative	0 or CD
$\bar{B}/\bar{Y}$	debt-to-GDP ratio	0

Parameter restrictions

	Restrictions		
param.	theory	econ.	calibr.
$\frac{\bar{X}}{\bar{Y}}$	$= \frac{\delta\theta}{\bar{R}-1+\delta}$	inv. share	25.7%
$\frac{\bar{C}^{(W)}}{\bar{Y}}$	$1-\theta-(\bar{R}-1)\frac{\bar{B}}{\bar{Y}}$	cons. share (W)	60%
$\frac{\bar{C}^{(C)}}{\bar{Y}}$	$1-\frac{\bar{X}}{\bar{Y}}-\frac{\bar{C}^{(C)}}{\bar{Y}}$	cons. share (C)	14.3%
$\kappa = \frac{\eta_{cl,c}^{(W)}}{\eta_{cl,l}^{(W)}}$	$= \frac{(1-\bar{L})}{\bar{L}} \frac{\frac{\bar{C}^{(W)}}{\bar{Y}}}{(1-\theta)}$	rel.exp.shares	0.5
$\eta_{ll}^{(W)}$	$\geq \frac{\kappa\left(\eta_{cl,l}^{(W)}\right)^2}{\eta_{cc}}$	leis.risk.av.	0, ∞ or (

Cons. volatility of capitalist:

- To nail the Sharpe ratio with this model and a relative risk aversion of two, the consumption of the capitalist must be quite volatile,

$$\sigma_c^{(C)} \geq \frac{SR}{\eta_{cc}^{(C)}} = \frac{0.27}{2} = 13.5\% \text{ for } k = 4$$

- Plausible? Evidence on luxury goods, see Aït-Sahalia - Parker - Yogo (2002).

Parameters

- E.g. Cobb Douglas preferences:

$$U(C_t, L_t) = \frac{(C_t^{\nu}(1 - L_t)^{1-\nu})^{1-\alpha_i}}{1 - \alpha_i}$$

  where $\nu = 0.64$ for both types of agents, and $\alpha_i = 2$ for capital holders, but $\alpha_i = 10$ for workers.

- As in Guvenen: $\xi = 0.23$.

- Guvenen (2003): $\sigma_\epsilon = 2$. Here: $\sigma_\epsilon = 0.712$. **This reduces the Sharpe ratio by nearly a factor of three compared to Guvenen.**

Two-agent economy.

σ_y	σ_n	σ_c	σ_x	$\rho_{n,y}$	$\rho_{c,y}$	$\rho_{x,y}$	SR	σ_{rf}
Fixed labor:								
0.91	0.00	0.90	0.93	-1.00	1.00	1.00	0.06	0.58
Flexible labor:								
0.22	1.16	0.21	0.24	-1.00	1.00	1.00	0.02	0.16
Cobb-Douglas utility:								
0.99	0.14	1.05	0.83	1.00	1.00	1.00	0.06	0.52
Slow adjustment of wages, $\mu = 0.97$:								
1.70	1.68	1.57	2.04	0.89	1.00	1.00	0.15	2.77
U.S. data:								
2.13	1.79	1.30	8.07	0.86	0.82	0.86	0.26	1.7

Fix 3: two agents.

- Verdict: This does not do much. Agents share and shift risk to where it hurts the least, ...
- ... unless wages are sluggish. But for that, one does not need a two-agent model.
- In fact, the representative agent model looks better, if anything.

Overview

1. Introduction •
2. Asset pricing •
3. Macroeconomic consequences •
4. A two agent model. •
5. **Conclusions.**

Conclusions

- High risk aversion is not enough.
- Fix 1: non-separability between consumption and leisure. Does not work.
- Fix 2: frictions on labor markets, exogenous wages. This works. Plausible?
- Fix 3: heterogeneous agents. Does not work.
- (Fix 4: Epstein-Zin preferences. This works. Another paper.)
- “Generic” real business cycle model.
- Nonseparability: consumption vs leisure.

Conclusions 2.

- **Mutual discipline** of asset market observations and macroeconomic observations:
  - **Economic choices** such as consumption and leisure ...
  - are taken as **exogenous** in **asset pricing literature** and suggest preference specifications, ...
  - which in turn may have undesirable **macroeconomic consequences**, once these **economic choices are endogenized**.
- **Key: alternative labor market paradigm.** Exogenous law for wage movement does the trick!

Campbell-Cochrane.

- $$E_0 \left[\sum_{t=0}^{\infty} \delta^t \frac{(C_t - X_t)^{1-\gamma} - 1}{1-\gamma} \right]$$
- Surplus consumption ratio
$$S_t^a \equiv (C_t^a - X_t)/C_t^a$$
- Use lower-case to denote logs.

Campbell-Cochrane 2.

- Assumption:

$$s_{t+1}^a = (1-\phi)\bar{s} + \phi s_t^a + \lambda(s_t^a)\left(c_{t+1}^a - c_t^a - g\right),$$

where $\phi \in [0,1)$, g and $\bar{s}$ are parameters, and

$$\lambda(s^a) = \begin{cases} \bar{S}^{-1}\sqrt{1-2(s^a-\bar{s})} - 1, & s^a \leq s_{max}; \\ 0, & s^a \geq s_{max}; \end{cases}$$

- Campbell-Cochrane: assume consumption to be an exogenous random walk.
- Explains lots of asset pricing facts.

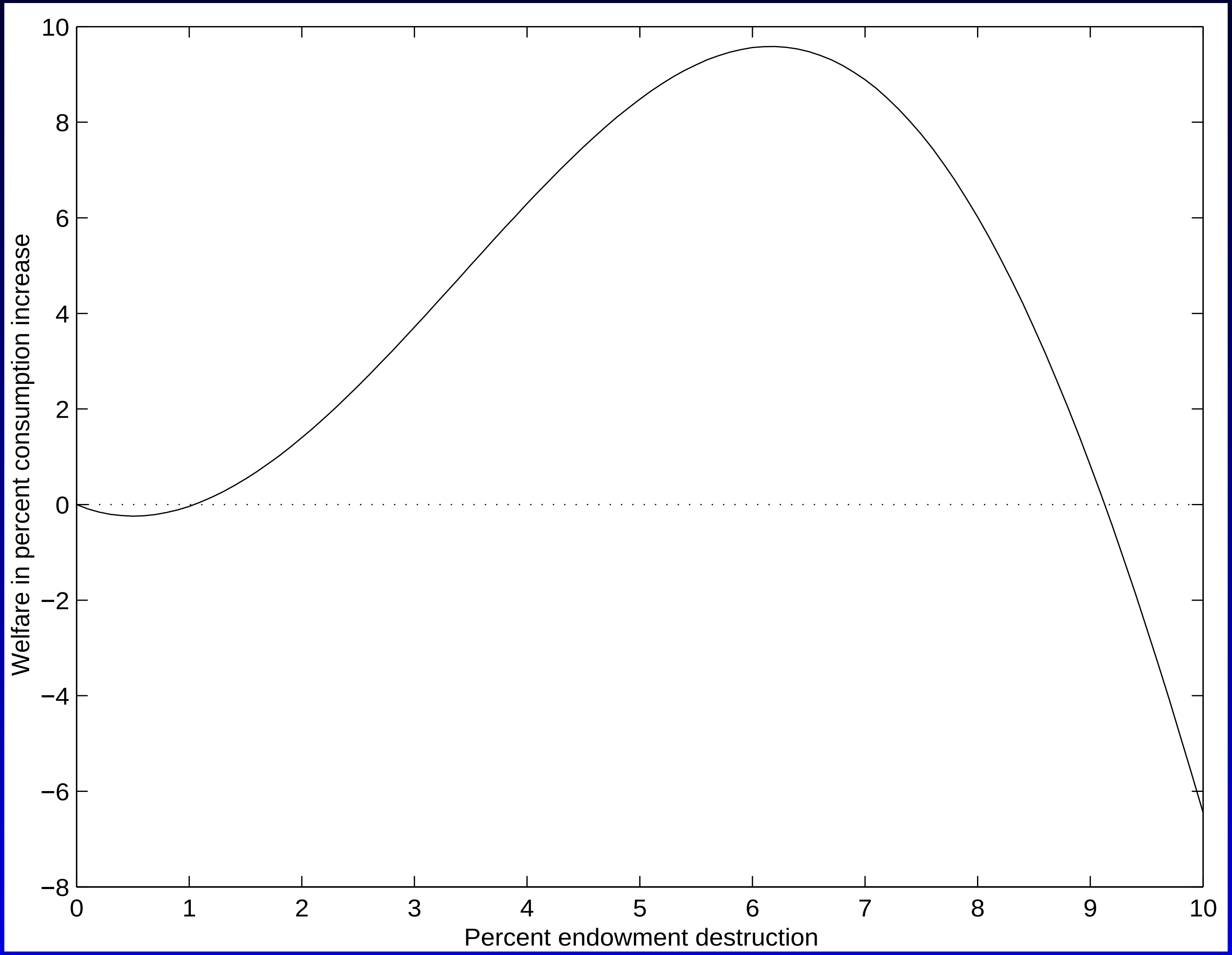
Ljungqvist-Uhlig

- Ljungqvist-Uhlig: consider an economy with a constant stream of endowment. Let an agent with CC-preferences choose consumption, subject to consumption $\leq$ endowment.
- Analyze the social planners problem

Ljungqvist-Uhlig, 2

- A one-time destruction of consumption or periodic destruction of consumption vastly increases welfare.
- Optimal decision rule look bizarre. Results preliminary.
- CC preferences are nonconcave.
- Habit decreases in consumption when increasing consumption by more than 20%.

Welfare gains



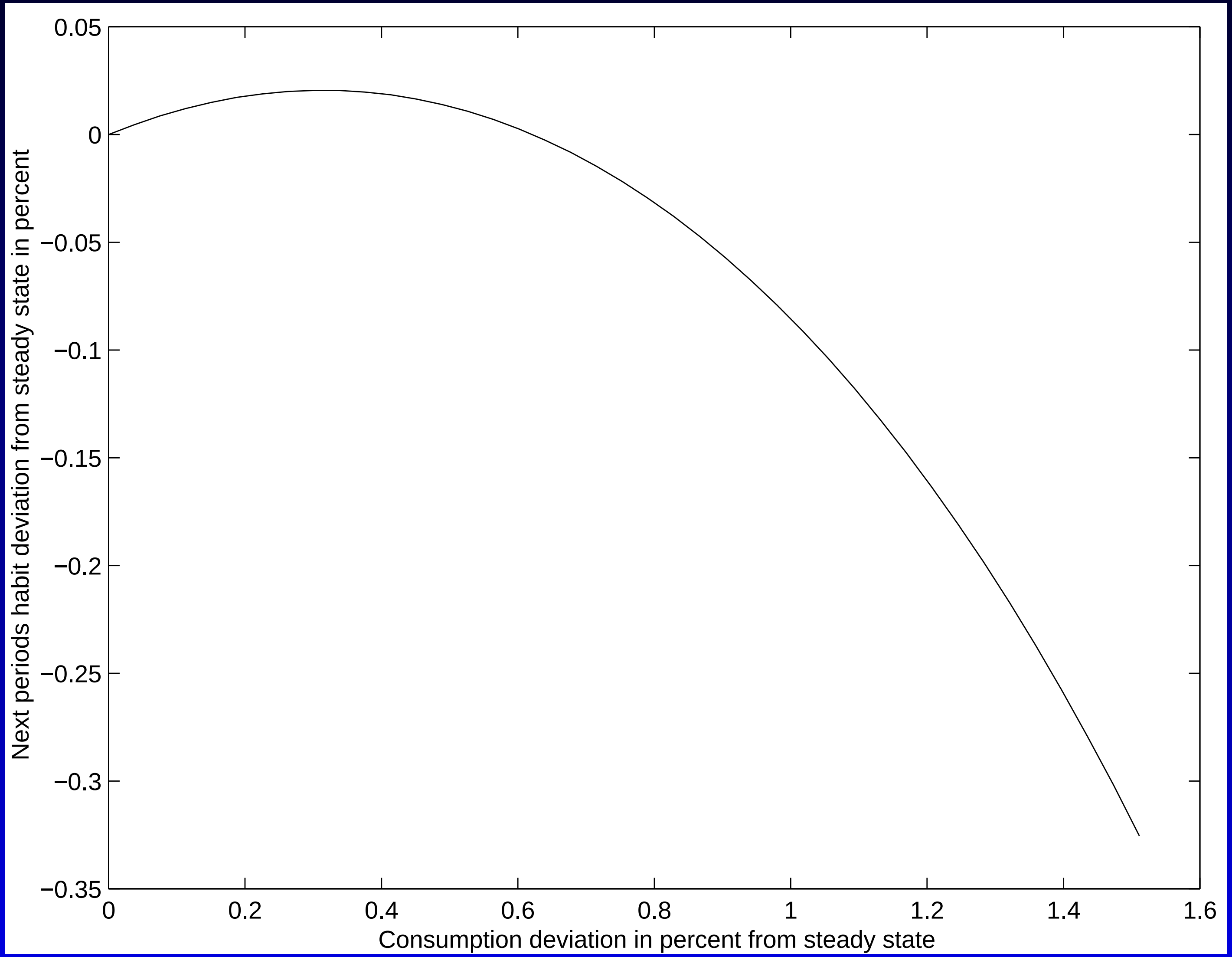
... from a one-time endowment destruction.

Welfare gains

k	1%	5%	10%	15%
2	4.89	8.36	13.66	8.68
6	2.48	9.08	15.45	9.65
12	1.37	9.03	15.91	9.86
24	0.72	8.52	15.89	9.89
120	0.24	4.95	13.40	8.51

... from periodic destruction every k periods.

Habit function.



Next-period habit as function of consumption.

Decision rule for consumption

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