A Macroeconomic Model of Equities and Real, Nominal, and Defaultable Debt

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Motivation

Goal: Show that a simple macroeconomic model (with Epstein-Zin preferences) is consistent with a wide variety of asset pricing facts

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- long-run risks: Bansal-Yaron (2004) et al.
- heterogeneous agents: Mankiw-Zeldes (1991), Guvenen (2009), Schmidt (2015), et al.
- financial intermediaries: Adrian-Etula-Muir (2013)

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Two key ingredients:

- Epstein-Zin preferences
- nominal rigidities

Households

Period utility function:

$$u(c_t, l_t) \equiv \log c_t - \eta \frac{l_t^{1+\chi}}{1+\chi}$$

- additive separability between c and l
- SDF comparable to finance literature
- log preferences for balanced growth, simplicity

Flow budget constraint:

$$a_{t+1} = e^{i_t} a_t + w_t l_t + d_t - c_t$$

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Calibration: (IES $= 1$), $\chi = 3$, $l = 1$ ($\eta = .54$)

Generalized Recursive Preferences

Household chooses state-contingent $\{(c_t, l_t)\}$ to maximize

$$V(a_t;\theta_t) \;=\; \max_{(c_t,l_t)} u(c_t, l_t) - \beta\alpha^{-1}\log\left[E_t \exp(-\alpha V(a_{t+1};\theta_{t+1}))\right]$$

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Calibration: $\beta = .992$, RRA (R^c) $= 60$ $\quad(\alpha = 59.15)$

Firms

Firms are very standard:

- continuum of monopolistic firms (gross markup λ)
- Calvo price setting (probability $1 - \xi$)
- Cobb-Douglas production functions, $y_t(f) = A_t k^{1-\theta} l_t(f)^\theta$
- fixed firm-specific capital stocks k

Random walk technology: $\log A_t = \log A_{t-1} + \varepsilon_t$

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Calibration: $\lambda = 1.1$, $\xi = 0.8$, $\theta = 0.6$, $\sigma_A = .007$, $(\rho_A = 1)$, $\frac{k}{4Y} = 2.5$

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No government purchases or investment:

$$Y_t = C_t$$

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Calibration: $\phi_\pi = 0.5, \ \phi_y = 0.75, \ \overline{\pi} = .008, \ \rho_{\bar{y}} = 0.9$

Solution Method

Write equations of the model in recursive form

Divide nonstationary variables (Y_t, C_t, w_t, etc.) by A_t

Solve using perturbation methods around nonstoch. steady state

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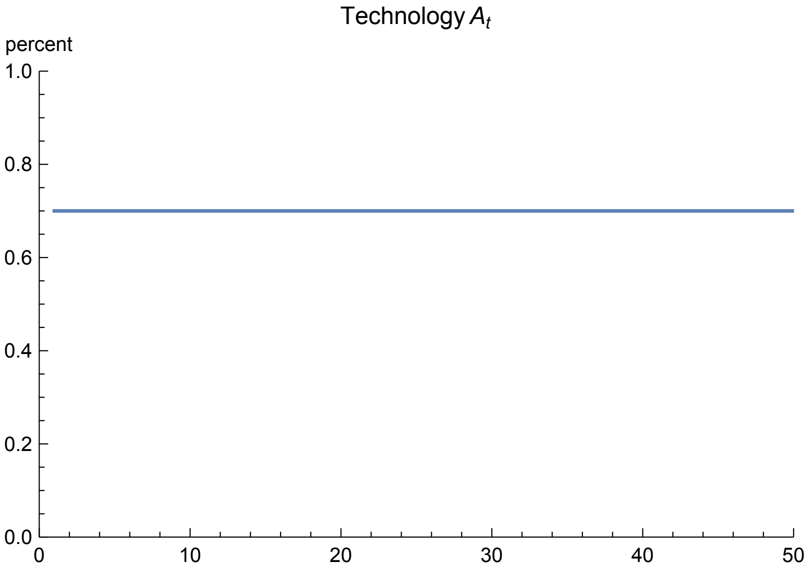
Solve using perturbation methods around nonstoch. steady state

- first-order: no risk premia
- second-order: risk premia are constant
- third-order: time-varying risk premia
- higher-order: more accurate over larger region

Model has 2 state variables ($\bar{y}_t$, Δ_t), one shock (ε_t)

Impulse Responses



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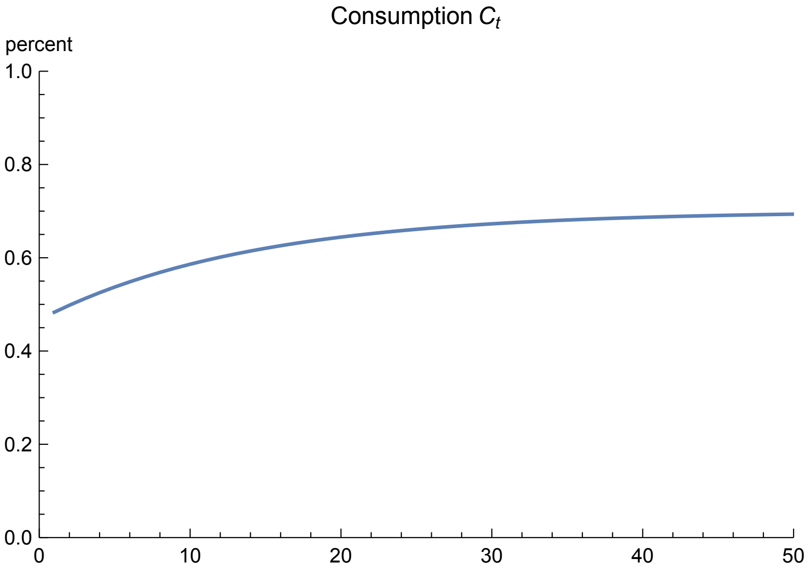

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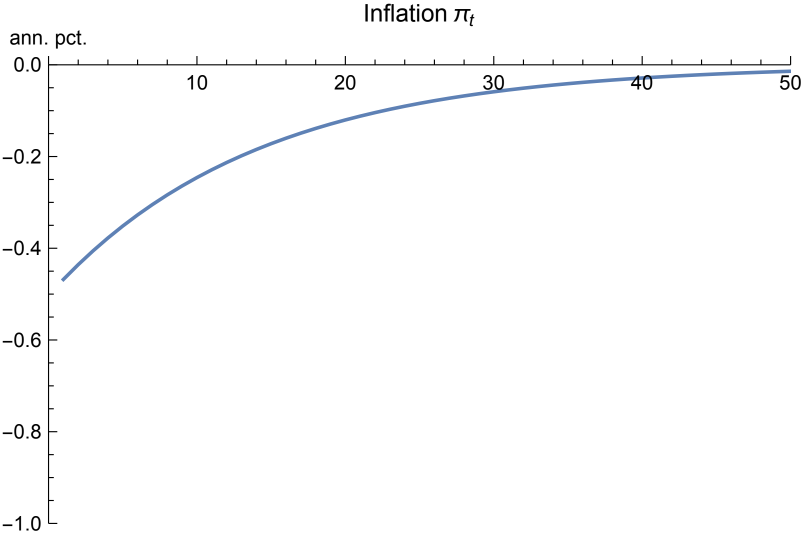

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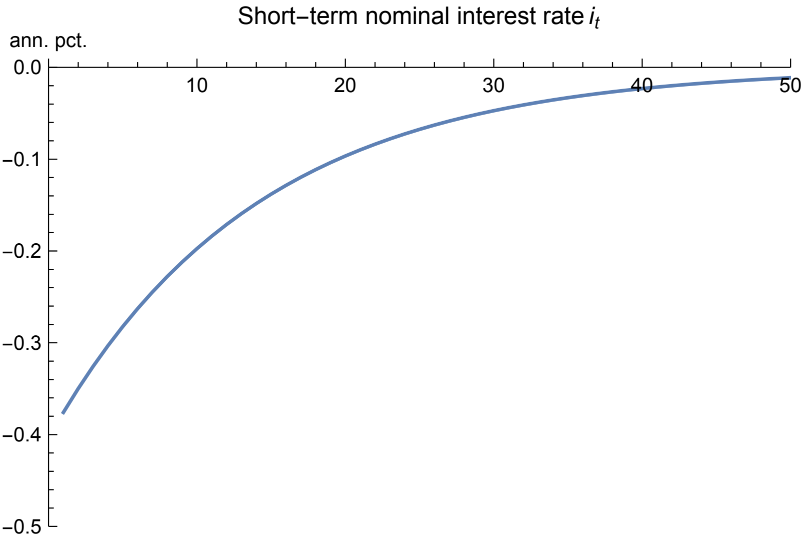

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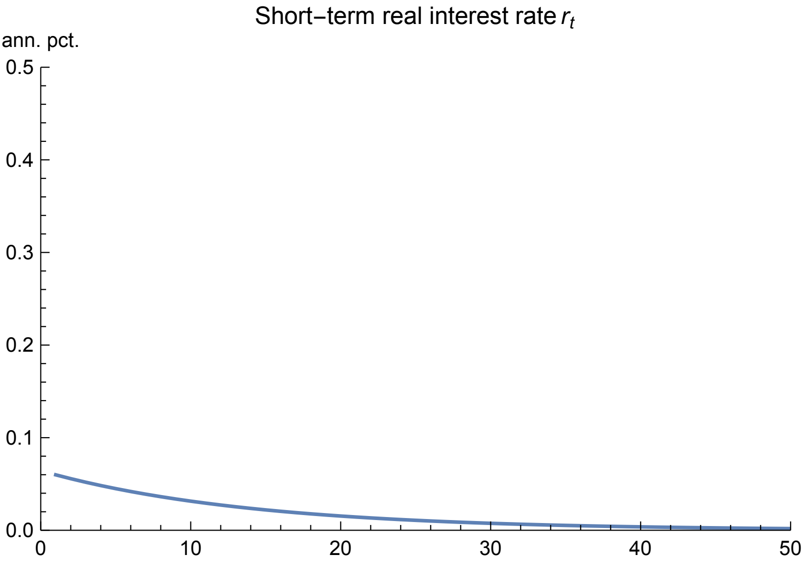

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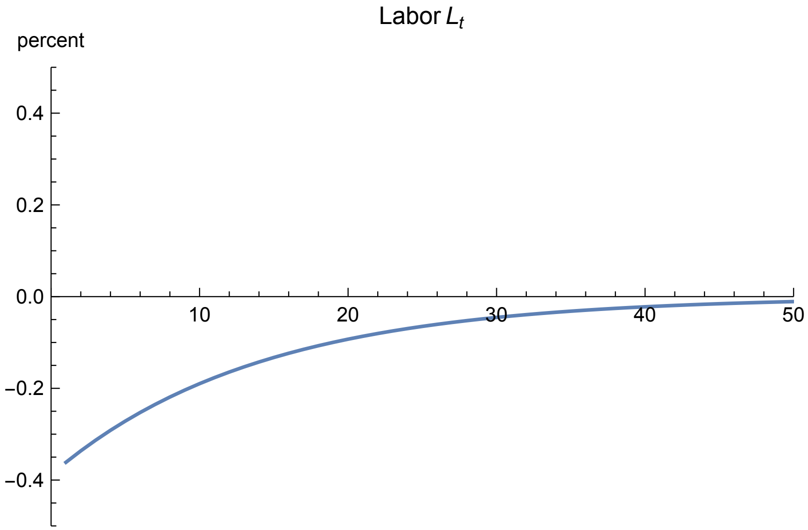

Equity: Levered Consumption Claim

Equity price

$$p_t^e = E_t m_{t+1} (C_{t+1}^{\nu} + p_{t+1}^e)$$

where ν is degree of leverage

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Calibration: $\nu = 3$

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60	.995	1.86
60	.99	1.08
60	.98	0.53
60	.95	0.17

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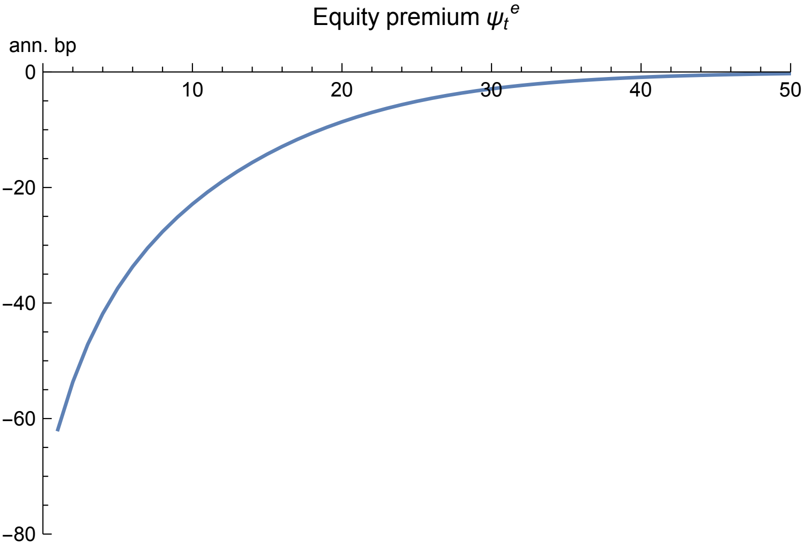

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Real Yield Curve

Table 3: Real Zero-Coupon Bond Yields

	2-yr.	3-yr.	5-yr.	7-yr.	10-yr.	(10y)−(3y)
US TIPS, 1999–2016[a]			1.22	1.48	1.75	
US TIPS, 2004–2016[a]	0.11	0.24	0.56	0.84	1.16	0.92
US TIPS, 2004–2007[a]	1.42	1.53	1.75	1.92	2.10	0.57
UK indexed gilts, 1983–1995[b]	6.12	5.29	4.34		4.12	−1.17
UK indexed gilts, 1985–2015[c]		1.91	2.05	2.16	2.25	0.34
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macroeconomic model	1.94	1.93	1.93	1.93	1.93	0.00

[a] Gürkaynak, Sack, and Wright (2010) online dataset
[b] Evans (1999)
[c] Bank of England web site

Nominal Yield Curve

Table 4: Nominal Zero-Coupon Bond Yields

	1-yr.	2-yr.	3-yr.	5-yr.	7-yr.	10-yr.	(10y)−(1y)
US Treasuries, 1961–2016[a]	5.19	5.41	5.60	5.88	6.10		
US Treasuries, 1971–2016[a]	5.31	5.55	5.75	6.08	6.33	6.60	1.29
US Treasuries, 1990–2007[a]	4.56	4.84	5.06	5.41	5.68	5.98	1.42
UK gilts, 1970–2015[b]	6.92	7.10	7.26	7.51	7.70	7.89	0.96
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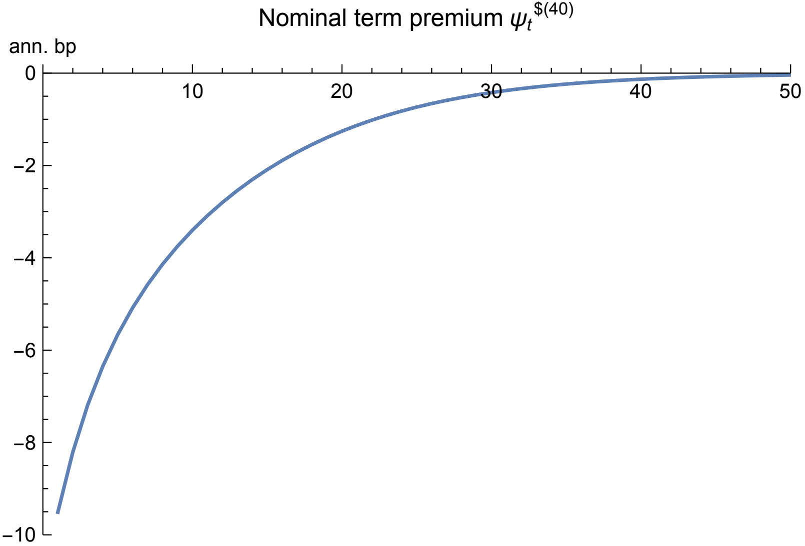
Supply shocks make nominal long-term bonds risky: inflation risk

Nominal Term Premium



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The credit spread is $i_t^d - i_t^c$

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average ann. default prob.	cyclicality of default prob.	average recovery rate	cyclicality of recovery rate	credit spread (bp)
.006	0	.42	0	34.0

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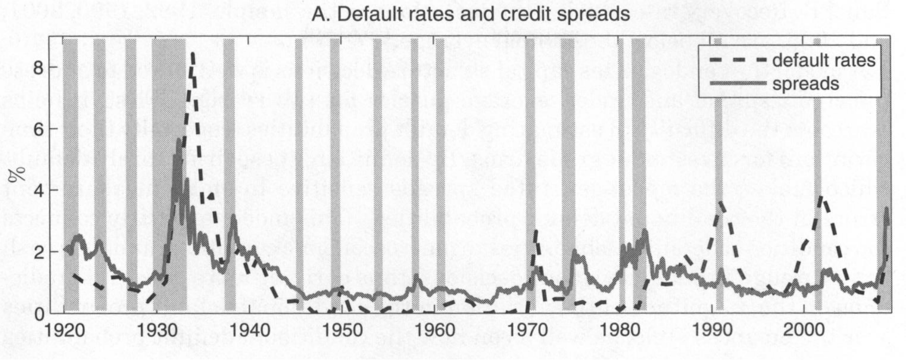
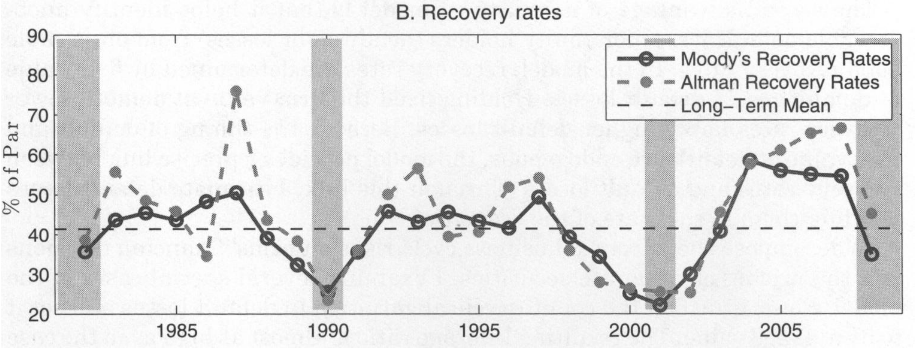
If default isn't cyclical, then it's not risky

Default Rate is Countercyclical



source: Chen (2010)

Recovery Rate is Procyclical



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.006	−0.3	.42	2.5	143.1
.006	−0.15	.42	2.5	78.9
.006	−0.6	.42	2.5	367.4
.006	−0.3	.42	1.25	137.0
.006	−0.3	.42	5	155.2

Discussion

1. IES ≤ 1 vs. IES > 1
2. Volatility shocks
3. Endogenous conditional heteroskedasticity
4. Monetary and fiscal policy shocks
5. Financial accelerator

Intertemporal Elasticity of Substitution

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Model here satisfies both criteria with IES $= 1$ (or even < 1).

Monetary and Fiscal Policy Shocks

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But technology shock is most important (by far) for fitting asset prices:

- technology shock is more persistent
- technology shock makes nominal assets risky

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...but not in this paper

Conclusions

1. The standard textbook New Keynesian model (with Epstein-Zin preferences) is consistent with a wide variety of asset pricing facts/puzzles
2. Unifies asset pricing puzzles into a single puzzle—Why does risk aversion and/or risk in macro models need to be so high? (Literature provides good answers to this question)
3. Provides a structural framework for intuition about risk premia
4. Suggests a way to model feedback from risk premia to macroeconomy