Volatility, the Macroeconomy and Asset Prices by Ravi Bansal, Dana Kiku, Ivan Shaliastovich, Amir Yaron

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My view of paper's aim:

Study how **volatility in risk prices** combined **with volatility in returns on aggregate consumption claim** impact

- joint dynamics of risk-return relation for human capital and aggregate equity
- cross-section of equity risk premia

Why do we care?

- Why do we care about stochastic risk prices
- Why do we care about valuing human capital and aggregate equity?
- Why do we care about cross-sectional asset pricing?

- Value of human capital has large impact on welfare.
  - Share of human wealth in overall wealth $\approx 80\%$, (Lustig & Van Niewerburgh, 2008)
  - All progress ultimately depends on human ingenuity: correct valuation of human capital has important implications for investment in education, etc.
- To correctly assess welfare implications of policies need a macro-finance model which accurately values human capital in addition to aggregate cash flows.
- Cross-sectional puzzles in asset pricing should ultimately be related to sector/industry/firm specific characteristics. Eventually use understanding of cross-sectional risk premia to assess policy implications on a sector by sector basis.

Stochastic risk prices. Why?

- Aggregate risk premium important because large aggregate risk premium $\iff$ large welfare cost of business cycles (Lucas)
- Risk premia are determined by risk prices
  - No arbitrage & complete markets $\Rightarrow \exists!$ strictly positive SDF , $M = e^m$
  - standard dynamic asset pricing eqn:
    $$E_t[r_{t+1} - r_{ft}] = -Cov_t(\underbrace{m_{t+1} - E_t[m_{t+1}]}_{\text{unexp. change in log SDF: gives risk prices}}, r_{t+1} - E_t[r_{t+1}])$$
- Facts about risk premia
  - Market risk premium are large relative to 1st generation models (Mehra –Prescott)
  - Market risk premium is stochastic (time – varying) (Schiller) – countercyclical
- Implications for risk prices
  - Risk prices are large and stochastic (countercyclical)

Finding a sensible SDF

- Minimum requirements: SDF with large and stochastic (countercyclical) risk price
- Adding economic meat to financial ketchup: get SDF from assumptions about household preferences and aggregate consumption
- 1st generation models: CRRA + log normal consumption – risk premia small and constant: price of risk small and constant
- Choose one of several 2nd generation models which generate reasonable aggregate risk premium with large and countercyclical risk prices
  - Campbell-Cochrane (external habit)
  - Bansal & Yaron (LRR)
  - time-varying disaster risk (Rietz, Barro)
- Maybe explore a 3rd generation model? :
  - CRRA, heterogeneity in risk aversion, OLG
  - CRRA, heterogeneity in beliefs and learning, OLG
- Beware: all above models are consumption based. None include labor income in dynamic budget constraint or labor/leisure in utility function. Limits understanding of how human capital is valued.

This paper: LRR SDF

- Source of large and stochastic (countercyclical) risk price
  - Continuum of identical EZW households: consumers, no labor/leisure trade - off. Get single EZW rep agent who consumes aggregate cons.
  - Exog. agg. cons: conditionally lognormal with stochastic expected cons growth, which itself has stochastic vol

$$
\begin{aligned}
c_{t+1} - c_t &= \mu + x_t + \sigma \eta_{t+1} \\
x_{t+1} &= \rho x_t + \phi_e \sigma_t \epsilon_{t+1} \\
\sigma_{t+1}^2 &= \sigma_c^2 + \nu(\sigma_t^2 - \sigma_c^2) + \sigma_w w_{t+1}
\end{aligned}
$$

  - $\gamma \neq \frac{1}{\psi}$: rep. agent cares about whether uncertainty is resolved sooner or later
    - shocks to expectations are priced
    - vol of shocks to expectations are priced

$$m_{t+1} - E_t[m_{t+1}] = -\overbrace{\gamma}^{\text{price of shock to cons growth:}} \eta_{t+1}$$

$$-\overbrace{\left(\gamma - \frac{1}{\psi}\right)\frac{\kappa_1}{1-\kappa_1\rho}\phi_e\sigma_t}^{\text{price of shock to expected cons growth: this is stochastic}} \epsilon_{t+1}$$

$$-\left\{\underbrace{-\left(\gamma - \frac{1}{\psi}\right)(\gamma - 1)\frac{\kappa_1}{1-\nu\kappa_1}\frac{1}{2}\left[1 + \left(\frac{\kappa_1}{1-\rho\kappa_1}\right)^2\right]\sigma_w}_{\text{price of vol of shock to expected cons. growth}}\right\} w_{t+1}$$

- Preference for early resolution of intertemporal risk: $\gamma > \frac{1}{\psi}$
- Increases size of risk price
- Combined with stoch. vol., σ_t: countercyclical price of expected cons. growth risk

Defining volatility

$$V_t = \frac{1}{2} Var_t[m_{t+1} + r_{c,t+1}] \tag{1}$$

Human capital and news about expected consumption growth

- LRR SDF $\Rightarrow$

$$\overbrace{(E_{t+1}-E_t)\sum_{j=1}^{\infty}\kappa_1(c_{t+j+1}-c_{t+j})}^{\text{news about cons growth}} = \psi N_{DR,t+1} - \frac{\psi-1}{\gamma-1}N_{V,t+1}$$

where

$$\overbrace{N_{DR,t+1}}^{\text{news about discount rates}} = (E_{t+1}-E_t)\left(\sum_{j=1}^{\infty}\kappa_1^j r_{c,t+1}\right) \quad (2)$$

$$\underbrace{N_{V,t+1}}_{\text{news about vol}} = (E_{t+1}-E_t)\left(\sum_{j=1}^{\infty}\kappa_1^j V_{t+j}\right) \quad (3)$$

- Assume share of human wealth on total wealth is constant, ω

$$N_{DR,t+1} = \omega N^y_{DR,t+1} + (1-\omega)N^d_{DR,t+1} \quad (4)$$

- Main eqn for understanding news about human capital discount rate

$$\overbrace{(E_{t+1} - E_t) \sum_{j=1}^{\infty} \kappa_1 (c_{t+j+1} - c_{t+j})}^{\text{news about cons growth}} = \psi N_{DR,t+1} - \frac{\psi - 1}{\gamma - 1} N_{V,t+1}$$

$$N_{DR,t+1} = \omega N^y_{DR,t+1} + (1 - \omega) N^d_{DR,t+1}$$

- Without stochastic risk price, $N^d_{DR,t+1}$ and $N^y_{DR,t+1}$ must be of opposite sign to make sure news about cons growth is small enough: returns on human capital and dividends negative correlated (Lustig & Van Niewerburgh, 2008)
- With stochastic risk price and $\gamma > 1, \psi > 1$ (implied by $\gamma > \frac{1}{\psi} > 1$), can have $N^d_{DR,t+1}$ and $N^y_{DR,t+1}$ of the same sign: returns on human capital and dividends positively correlated

Importance of labor income

1. Labor income is part of dynamic budget constraint
2. Could (should?) put labor into utility function: figure out new SDF

- Just do 1 (quick and dirty).

$$W_{t+1} = (W_t + E_t - C_t)R_{c,t+1} \tag{5}$$

$$W_{t+1} = (W_t - \underbrace{C_t^-}_{\text{cons minus labor income}})R_{c,t+1} \tag{6}$$

- But this does not impact *SDF*, so still have

$$\overbrace{(E_{t+1} - E_t)\sum_{j=1}^{\infty} \kappa_1 (c_{t+j+1} - c_{t+j})}^{\text{news about cons growth}} = \psi N_{DR,t+1} - \frac{\psi - 1}{\gamma - 1} N_{V,t+1}$$

$$N_{DR,t+1} = \omega N_{DR,t+1}^{y} + (1-\omega) N_{DR,t+1}^{d}$$

EZW preferences with labor

- Put labor into utility function: change SDF and get new expression for how news about consumption growth is related to news about vol shocks

$$
\begin{aligned}
U_t &= f(C_t^*, CEQ_t[U_{t+1}]), \\
f(x,y) &= \left(x^{1-\frac{1}{\psi}} + y^{1-\frac{1}{\psi}}\right)^{\psi} \\
CEQ_t[U_{t+1}] &= \left(E_t[U_{t+1}^{1-\gamma}]\right)^{\frac{1}{1-\gamma}} \\
C_t^* &= g(C_t, \overline{N} - N_t) \\
&= C_t(\overline{N} - N_t)^{\tau}
\end{aligned}
$$

- E.g. Kung (2012)

New SDF with labor

- new log SDF

$$m_{t+1} = \text{cst} - \frac{1}{\psi}\Delta c_{t+1} + \tau\left(1 - \frac{1}{\psi}\right)\left(\underbrace{\Delta l_{t+1}}_{\text{change in log labor income}} - \underbrace{\Delta w_{t+1}}_{\text{change in log wages}}\right) + \text{cst}\, r_{c,t+1}$$

- Will we risk prices be such that we get a realistic equity premium?
- Risk-free rate?
- $\psi > 1$?

- New eqn

$$\overbrace{(E_{t+1}-E_t)\sum_{j=1}^{\infty}\kappa_1(c_{t+j+1}-c_{t+j})}^{\text{news about cons growth}}$$

$$-\,cst\cdot\overbrace{(E_{t+1}-E_t)\sum_{j=1}^{\infty}\kappa_1(l^*_{t+j+1}-l^*_{t+j})}^{\text{new news term}}$$

$$=\text{cst}\cdot N_{DR,t+1}-\text{cst}\cdot N_{V,t+1}$$

$$N_{DR,t+1}=\omega N^y_{DR,t+1}+(1-\omega)N^d_{DR,t+1}$$

- Sign of last cst crucial for vol risks

- Volatility for aggregate stock returns > Vol in aggregate dividend growth

$$\overbrace{r_{t+1} - E_t[r_{t+1}]}^{\text{unexpected change in stock returns}} = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j} - (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r_{t+1}$$

$$= \underbrace{ECF_{t+1}}_{\text{expected CF news}} - \underbrace{EDR_{t+1}}_{\text{expected DR news}}$$

- expected DR news drives unexpected change in stock returns