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

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# Macro-Financial Linkages in Macro Models

- some pre-crisis macro models featured interesting macro-finance linkages
  1. *Kyotaki and Moore*
  2. *Bernanke, Gertler and Gilchrist*

- prior to crisis, workhorse macro models used in policy-making
  - largely ignored risk premia,
  - did not emphasize linkages between financial markets and macro-economic outcomes

  1. *Smets and Wouters*
  2. *Christiano, Eichenbaum and Evans*

- good fit in pre-crisis U.S. data without these linkages (e.g. LTCM crisis in 1998)

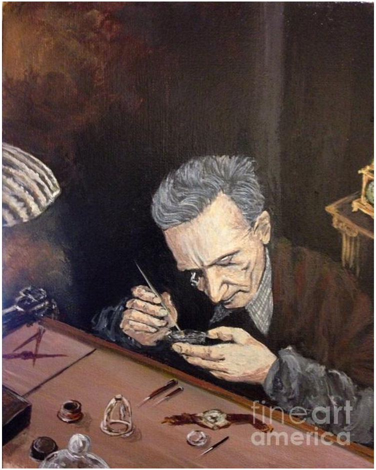
# This Paper: Rudebusch and Swanson 2.0

- build a tractable macro-finance model that matches macro quantities and asset prices in government debt, corporate bond and equity markets
  - no financial frictions
  - but nominal price rigidities

- model built to match variation in risk premia across broad range of asset classes and over time ✓
  - deliver SDF and cash flows that accomplish this ✓
  - without too many bells and whistles

- is the right to model to think about macro-financial linkages and financial crises?

# Master Watchmaker



# Key Ingredients in Swanson (2015)'s Model

1. representative agent with risk-sensitive preferences with $IES = 1, RRA = 60$:

$$V(c^t, l^t) = (1-\beta)u(c_t, l_t) - \beta\frac{1}{\alpha}\log\left(E_t[\exp\left(-\alpha V(c^{t+1}, l^{t+1})\right)]\right)$$

   - pricing kernel:

$$m_{t+1} = \beta\frac{c_t}{c_{t+1}}\frac{\exp\left(-\alpha V(c^{t+1}, l^{t+1})\right)}{E_t[\exp\left(-\alpha V(c^{t+1}, l^{t+1})\right)]}$$

2. labor supply choice, cannot accumulate physical capital $k_t$, but allow for unit root in productivity $\log A_t = \rho\log A_{t-1} + \epsilon_t, \epsilon_t \sim IID$

$$y_t = A_t k^{1-\theta} l_t^{\theta}$$

3. nominal prices are sticky

# Real Version of This Economy

# Key Ingredients in Backus, Ferriere and Zin (2015)

1. representative agent with risk-sensitive preferences with $IES = 1, RRA = 10$:

$$V(c^t) = \left[(1-\beta)c_t^\rho + \beta \left(\mu_t[V(c^{t+1})]\right)^\rho\right]^{1/\rho}; \mu(V) = E[V^\alpha]^\alpha$$

   - pricing kernel:

$$m_{t+1} = \beta \left(\frac{c_{t+1}}{c_t}\right)^{\rho-1} \left(\frac{V_{t+1}}{\mu_t[V_{t+1}]}\right)^{\alpha-\rho}$$

2. cannot supply labor but can accumulate physical capital $k_t$, with unit root in productivity

$$y_t = A_t k_t^{1-\theta} l_t^\theta$$

3. no nominal component

# Macro-Financial Dichotomy I

## Result

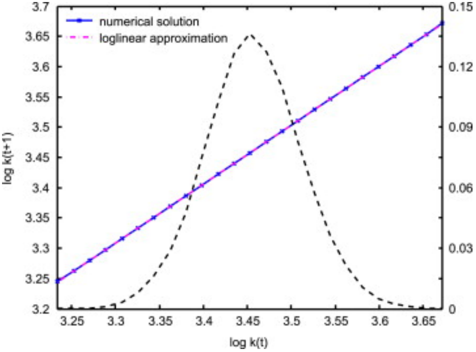
*Tallarini (2000) Property: In the BFZ/Tallarani economy, the behavior of quantities $(y_t, c_t, k_t)$ is affected by the IES but not uncertainty/risk aversion $\alpha$. 'The result applies to log-linear approximations, but we find the approximations hard to distinguish from more accurate solutions.'*

- we can pick $\alpha$ to match risk premia, $\sigma$ to match quantities
- choice of $\alpha$ does not impact endogenous dynamics of model

$$c_t - E_{t-1}c_t = r_t^m - E_{t-1}r_t^m + (1-\sigma)(E_t - E_{t-1})\sum_{j=1}\rho^j r_{t+j}^m$$

  - not interesting setting for studying macro-finance linkages
- Does Tallarini's result apply to $(y_t, c_t, l_t)$ in real version of Swanson economy? If not, why not?

# BFZ Approximation is Darned Good




Slope of controlled law of motion: loglinear approximation and numerical solution. *David Backus, Axelle Ferriere, Stanley Zin*, JME (2015).

# Macro-Financial Dichotomy II

**Result**

*Tallarini (2000) Property: In the BFZ/Tallarani economy, there is no time variation in any risk premia without time-variation in volatility of technology shocks.*

$$\log A_t = \rho \log A_{t-1} + \epsilon_t, \epsilon_t \sim IID$$

- follows from 'approximate' log-linearity
- Does Tallarini's result apply to $(y_t, c_t, l_t)$ in real version of Swanson economy? If not, why not?

# Macro-Financial Dichotomy III

## Result

*Separation property (BFZ, 2015)*: *'The impact of uncertainty on dynamics is limited by what we call the separation property: the endogenous dynamics of the capital stock are independent of uncertainty and its properties. More precisely, the response of consumption and next period's capital stock to today's capital stock is independent of the shocks and their properties, including shocks to uncertainty.'*

- uncertainty: heteroskedasticity in growth rate of $A_t$
- endogenous dynamics of model are invariant to introduction of uncertainty shocks
  - not interesting setting for studying macro-finance linkages
- Does Tallarini's result apply to $(y_t, c_t, l_t)$ in real version of Swanson economy? If not, why not?

# Bottomline on Class of Preferences

- recursive utility: intertemporal trade-offs are governed by *IES*, risk premia are governed by $\alpha$
  - harder to get interesting feedback from asset prices to quantities

    *A large body of work suggests that their [risk-sensitive preferences] extra flexibility is helpful in accounting for asset prices (Bansal and Yaron, 2004, for example) but has little impact on the behavior of macroeconomic quantities (Tallarini, 2000). Source: BFZ, 2015.*

- not true with habit preferences

# Unit Root in Productivity

- unit root in $A_t$ is necessary
  - without unit root we're (almost) in *Ross*' recovery theorem economy
  - no permanent shocks to level of marginal utility $\Lambda_t$

**Result**

*Largest risk premium in economy without unit root is longest maturity zero coupon bond (Bansal and Lehmann)*

$$
\begin{aligned}
R_{t,t+1}[1_\infty] &= \lim_{k\to\infty} \frac{E_{t+1}[\Lambda_{t+k}]}{\Lambda_{t+1}} \Big/ \frac{E_t[\Lambda_{t+k}]}{\Lambda_t}, \\
R_{t,t+1}[1_\infty] &= \frac{\Lambda_t}{\Lambda_{t+1}} = \frac{1}{m_{t+1}}
\end{aligned}
$$

- to get large equity premium (relative to term premium), we need most of the variance of pricing kernel to be driven by permanent shocks to level of marginal utility (*Alvarez and Jermann, Hansen and Scheinkmann*)

# Nominal Frictions

# Endogenous Countercyclical Variation in Sharpe Ratios

1. representative agent with risk-sensitive preferences with $IES = 1, RRA = 60$:
2. cannot accumulate physical capital $k_t$, but allow for unit root in productivity $\log A_t = \rho \log A_{t-1} + \epsilon_t, \epsilon_t \sim IID$

$$y_t = A_t k^{1-\theta} l_t^{\theta}$$

3. nominal prices are sticky: endogenous heteroskedasticity
   - price dispersion responds to i.i.d. aggregate shocks
   - price dispersion's sensitivity depends on history of shocks

- nominal side of *Swanson*'s model breaks the Tallarini/BFZ result?
- Please explain economics.
- is this the right mechanism for time-variation in risk premia?

# Conclusion

- tractable DAPM that matches lots of key asset pricing facts
- real version of model features macro/finance disconnect
  - risk aversion governs risk premia while IES governs quantities
  - learning about parameters would break the macro/finance disconnect
- but nominal version does not: are sticky prices behind risk premium variation?
- need a role for financial sector
- need a role for collateral
  - introduce non-linearity that stems from financial intermediation (see, e.g. *He and Krishnamurthy*)

# More Work to be done.